THE JOURNAL OF THE INSTITUTION OF PRODUCTION ENGINEERS

VOL. XXVII - No. 5 - May, 1948

Contents :

Published by THE INSTITUTION,
36, PORTMAN SQUARE, LONDON, W.1

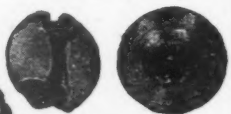
Telephone :
WELbeck 2232/3.
PRICE 5/-

unbrako STOOD THE TEST

The Unbrako Hexagon Socket Principle ensures adequate tightening torque without risk of damage to the screw.

Unbrako socket screws have a great tensile strength and ductility and are superior in finish to other screws.

Illustrations below show an Unbrako Socket screw subjected to the same conditions and length of service as a slotted head screw.



UNBRAKO

Manufactured by the

UNBRAKO SOCKET SCREW Co., Ltd., Burnaby Rd., Coventry

Stocked and Distributed by

CHARLES CHURCHILL & Co., Ltd., South Yardley, Birmingham

ERRATUM

BROACHING—MACHINES, TOOLS AND PRACTICE
by E. P. EDWARDS, M.I.P.E.

On page 310 of the above paper, which was published in the November, 1946, Journal, there appears the following formula :—

"Pitch $= \sqrt{\cdot 35 \text{ length of cut}}$".

This should of course read :—

"Pitch $= \cdot 35 \sqrt{\text{length of cut}}$".

The Council of the Institution

1947-48

President
N. ROWBOTHAM, C.B.E.

Chairman of Council
DR. H. SCHOFIELD, C.B.E.

Vice-Chairman
J. E. HILL

Past Presidents
Sir George E. Bailey, C.B.E. — The Rt. Hon. Viscount Nuffield, G.B.E.
J. D. Scaife — The Rt. Hon. Lord Sempill, A.F.C.

Vice-Presidents
T. Fraser, C.B.E. E. W. Hancock, M.B.E. H. A. Hartley Sir Norman V. Kipping

Section Presidents

F. Bernard White.....*Birmingham*
Dr. A. H. Pandya.....*Calcutta*
P. Tromans.....*Cornwall*
W. N. Ellerby.....*Coventry*
J. B. Webster.....*E. Counties*
J. L. Bennet.....*Edinburgh*
J. McFarlane.....*Glasgow*
J. Milwain.....*Halifax*
E. W. Harbot.....*Leicester*
B. A. Williams, O.B.E.....*Liverpool*
F. P. Laurens, O.B.E.....*London*
J. W. Buckley.....*Luton*
H. G. Gregory.....*Manchester*
Sir Claude D. Gibb, C.B.E., F.R.S.....*N. Eastern*
F. Allen.....*N. Ireland*
.....*Nottingham*
F. M. Kemp.....*Preston*
G. R. Pryor.....*Sheffield*
N. J. Cottell.....*Southern*
G. L. Norman, O.B.E.....*S. Wales & Mon.*
H. Bainbridge.....*Wolverhampton*
J. E. Attwood.....*Western*
W. Armstrong, M.B.E.....*Yorkshire*

Additional Section Representatives

F. C. White.....*Birmingham*
H. Burke.....*Birmingham*
A. W. Buckland.....*Coventry*
H. W. Bowen, O.B.E.....*London*
F. W. Halliwell.....*London*
R. K. Allan.....*Luton*
F. W. Cranmer.....*Manchester*
F. Osborne.....*Manchester*
J. F. Gibbons.....*N. Eastern*
A. S. Johnstone.....*Nottingham*
T. A. Westall.....*Preston*
J. T. Kenworthy.....*Western*
A. J. Aiers.....*Wolverhampton*
Lt.-Col. C. W. Mustill, M.B.E.....*Yorkshire*

Chairmen of Standing Committees
J. E. Baty E. P. Edwards R. E. Leakey F. H. Perkins

Elected Members
F. Bloor, R. M. Buckle, B. H. Dyson, L. R. Evans, R. C. Fenton,
W. V. Hodgson, E. J. H. Jones, M.B.E., R. Kirchner, W. C. Puckey
H. J. Swift, O.B.E., M. H. Taylor, S. Wright

Australian Sub-Council

President — **Chairman**
E. C. PARKINSON — *Not yet elected*

Vice-Chairman
E. L. Olfen

Elected Members
H. le Cheminant, W. G. Davis
J. Finlay, F. Glover
S. D. McPhee, C. Pullen
E. C. Parkinson, E. B. Richardson
J. M. Steer, J. E. Strick

South African Sub-Council

President — **Vice-President**
D. LION CACHET — A. B. ANDERSON

Past Presidents
L. H. L. Badham J. Henry

Elected Members
R. H. Arbuckle, W. Caldwell
W. Dunstan, E. G. Fox
W. Gillespie, J. Renwick
D. Ryder, H. H. Waters
J D. Williams, A. C. Wotherspoon

Director and General Secretary of the Institution
Major C. B. Thorne, M.C.

HONORARY MEMBERS OF THE INSTITUTION

The Council has for some time past conferred on those who have rendered the Institution long and distinguished service the title of Honorary Member.

At the present time, the Honorary Members of the Institution are :

Mr. T. Fraser, C.B.E.	Sir Alfred Herbert, K.B.E.
Sir Ernest J. H. Lemon, O.B.E.	The Rt. Hon. Viscount Nuffield, G.B.E., M.A., D.C.L.
Dr. G. Schlesinger.	The Rt. Hon. Lord Sempill, A.F.C.

Section Honorary Secretaries

Birmingham	A. J. Mansell, 204, Alcester Road South, Birmingham, 14.
Calcutta	J. Warren-Boulton, Machine Tools (India) Ltd., Stephen House, Dalhousie Square, Calcutta.
Cornwall	F. W. Spencer, "Pembroke," Phillack, Hayle, Cornwall.
Coventry	J. H. McDonald, 136, Crabmill Lane, Coventry.
Derby Sub-Section	A. Short, 26, St. Albans Road, Derby.
Eastern Counties	L. A. Childs, Messrs. Crane Ltd. ,Nacton Road, Ipswich.
Edinburgh	P. H. Lee, 39, Corstorphine Bank Drive, Edinburgh, 12.
Glasgow	W. P. Kirkwood, "Morar," Sandfield Avenue, Milngavie, Dumbartonshire.
Halifax	Miss N. E. Bottom (acting), Messrs. Hopkinsons, Ltd., Huddersfield.
Leicester and District	C. F. Gazard, 27, Stretton Road, Leicester.
Lincoln Sub-Section	E. E. Ingleton, "Glenroy," Lincoln Road, North Hykeham, near Lincoln.
Liverpool	F. Whitehead, 38, Cooper Avenue North, Mossley Hill, Liverpool.
London	F. E. Maer, "Green Gates," Batchworth Lane, Northwood, Middlesex.
Luton and Bedford	R. M. Buckle, 238, Cutenhoe Road, Luton, Beds.
Manchester	F. W. Cranmer, Associated British Machine Tool Makers, Ltd., Lloyds Bank Buildings, King Street, Manchester.
Melbourne (Victoria, Australia)	C. Pullen, 13, Immarna Road, Camberwell, E.6.
North Eastern	H. B. Topham, c/o Messrs. C. A. Parsons & Co., Heaton Works, Newcastle, 6.
Northern Ireland	W. G. Wyman, "Linden Lea," Cultra, Co. Down.
Nottingham	C. N. T. Manfull, Chellaston House, Thurgarton Street, Nottingham.
Preston	F. M. Kemp, "Aldwyn," Preston Old Road, Feniscowles, nr. Blackburn.
Sheffield	J. P. Clare, St. James' Chambers, 38, Church Street, Sheffield, 1.
Shrewsbury Sub-Section	R. O. L. Cadman, 5, Perseverance Terrace, East Road, Ketley Park, Oakengates, Salop.
South Africa	The Secretaries, Institution of Production Engineers, Barclays Bank Buildings, Corner Commissioner and Harrison Streets, Johannesburg.
Southern	S. Coates, 51, Westbury Road, Regent's Park, Shirley, Southampton.
South Wales and Monmouthshire	S. T. O. Davies, Messrs. John Curran Engineering, Ltd., Curran Road, Cardiff.
Sydney (New South Wales)	J. M. Steer, 260/262, Kent Street, Sydney.
Western	C. Newcombe, 12, Cleeve Gardens, Downend, Bristol.
West Wales Sub-Section	H. P. Sanderson, c/o I.C.I. Metals, Ltd., Waunarlwydd, near Swansea.
Wolverhampton	W. J. Marshall, Moston Park, Lee Brockhurst, Salop.
Yorkshire	J. L Townend, 26, Moor Allerton Drive, Street Lane, Leeds, 7.

Graduate Section Honorary Secretaries

Birmingham	N. Newey, 185, Selly Oak Road, King's Norton, Birmingham, 30.
Coventry	P. Powell, 57, Beaconsfield Road, Coventry.
Halifax	N. Jackson, "Waingate," Shepley, near Huddersfield.
London	J. E. Poulter, 14, Monument Road, Weybridge, Surrey.
Luton	F. Rowley, 195, Hitchin Road, Luton, Beds.
Manchester	W.R. Matley, 58, Heyscroft Rd., Withington, Manchester 20
North Eastern	G. Pool, 16, Kew Gardens, Monkseaton, Northumberland.
Wolverhampton	L. C. Jones, 1, Merridale Lane, Wolverhampton Staffs.
Yorkshire	W. R. Walton, 256, Belle Isle Road, Leeds, 10.

MR. WALTER C. PUCKEY, M.I.P.E., F.I.I.A

Institution Personalities — 3.

MR. W. C. PUCKEY, M.I.P.E., F.I.I.A.

MR. W. C. PUCKEY, M.I.P.E., F.I.I.A.

Walter C. Puckey, Director and General Works Manager of Hoover, Ltd., Member of the Institution of Production Engineers, Fellow of the Institute of Industrial Administration, has achieved fame in many spheres—among them, draughtsmanship, engineering, teaching, lecturing, writing—to quote only a few examples.

At the end of the last war he was serving his engineering apprenticeship with the Cosmos Engineering Company which later became absorbed in the Bristol Aeroplane Company, and he took part in the development of the first Bristol radial aero-engine. After 1920, he moved further afield, widening his knowledge and gaining practical experience as a draughtsman and designer with various firms in Lancashire, Yorkshire, and the South of England. He switched from one factory to another, studying textile machinery, heavy gun mechanisms, and obtaining all types of other useful knowledge.

He was successful not only as a student but also as a teacher, for at one time he lectured on mathematics and mechanical design to students only a little younger than himself, at Erith Technical College. As he grew older he maintained and developed his teaching ability until it now covers a more advanced field.

In 1937 Mr. Puckey was presented by Lord Nuffield with the Institution Medal for a paper entitled "Personal Problems of Management," and in 1944 he published a book entitled "What Is This Management?" The Right Hon. Oliver Lyttelton, in a foreword, described this book as "a contribution from an experienced and successful manager to our studies in the art and science of this vital subject." Yet with all his achievements and his success in his studies, his management and his private life, Mr. Puckey would above all things like to be regarded as a humanist.

The traits of human understanding are perhaps the real key to his success. He gained the co-operation of others by example and goodwill, rather than by coercion, and during the stormy times of switching from peace to war, produced the maximum possible war output. In changing back from war to peace, he saw that all proceedings were well planned and as far as practicable well understood by all concerned before they were carried out. They were then put into operation with the maximum efficiency in the minimum time.

At the age of 32, Mr. Puckey was Works Manager of a motor manufacturing company. He was invited to become Works Manager of Hoover, Limited, in July, 1935, and became a Director in April, 1944. During the war he was of course in close contact with various Ministries. He was a pioneer member of the Production Advisory Committee on Die-Casting initiated by the Ministry of Supply, and also served on the Industrial Panel of the Minister of Production. Recently, Mr. Puckey sat as an independent member on the Hosiery Working Party appointed by Sir Stafford Cripps.

INSTITUTION NOTES

May, 1948

BIRMINGHAM SECTION DINNER DANCE In spite of severe weather and transport difficulties, the Annual Dinner Dance held by the Birmingham Section on February 21st, 1948, was an outstanding success.

The function was attended by a number of prominent personalities, the chief guests being the Permanent Secretary to the Minister of Labour and National Service, Sir Godfrey H. Ince, K.C.B., K.B.E., C.B., and Lady Ince. Others present included Professor T. U. Matthew, who was recently appointed to the Lucas Chair in the Principles of Engineering Production at Birmingham University, the Rt. Hon. Lord Sempill, A.F.C., Sir Anthony Bowlby, Bart., Mr. C. W. Griffiths, Major C. B. Thorne, M.C., Director and General Secretary of the Institution, and Mr. F. B. White, M.I.P.E., Birmingham Section President.

In proposing the toast to the Institution, Sir Godfrey Ince emphasised that there was no easy way of recovering economic stability—it had to be achieved by the united efforts of the nation. An immediate increase in production of at least ten per cent was essential to recovery, and production engineers more than anyone else could help to reach this target.

Lord Sempill, in reply, expressed the opinion that national salvation lay in hard living and hard working.

MR. E. W. HANCOCK, M.B.E., M.I.P.E. Members of the Institution will be pleased to learn that Mr. E. W. Hancock, M.B.E., whose progressive ideas have done so much in helping to broaden the scope of the Institution of Production Engineers, has joined the Board of the Humber Company. He undertook the duties of General Manager (Works) on April 1st, 1948.

Mr. Hancock is well known in the automobile and allied industries, and has been Works General Manager with Messrs. Rubery Owen & Co. Ltd., Darlaston, since August 1942. Previously he held the position of Works Manager of the Humber Company for six years. He has also been Planning Department Manager of Messrs. Vauxhall Motors, Luton, and Works Manager of the Daimler Motor Co. Ltd., Coventry and its Associated Company, Messrs. B.S.A., Birmingham.

Mr. Hancock has done sterling work for the Institution during his long membership, and is a Past Chairman of Council and Past President of both the Coventry and Wolverhampton Sections. In

1946 he represented the Institution as the guest of the American Society of Tool Engineers at their first post-war Convention at Cleveland, Ohio, and it is mainly due to his efforts that an important liaison with this organisation has been established.

EMPLOYMENT IN SOUTH AFRICA In response to a number of enquiries from members concerning the prospects of employment in South Africa, the following facts were supplied by our South African branch in Johannesburg, and may be of interest to others considering emigration.

At present the acute material supply shortage is having serious effects on expansion in engineering. This naturally has reduced the number of vacancies for engineers and persons desiring executive positions in existing engineering companies.

The prospects for starting up new businesses are not very promising—this is again due to material shortage, and it is anticipated that this state of affairs will prevail for the next 18 months to two years.

Accommodation also presents difficulties, although here the position has improved slightly over the past twelve months.

Members who are considering emigration to this Dominion are strongly advised to consult the Immigration Council which has been established in England by the South African Government. The address is : London Immigration Council for South Africa, 39, Princes Gate, London, S.W.7.

NEWS OF MEMBERS

Mr. A. F. Allen, Int.A.M.I.P.E., has recently taken up an appointment as Chief Planning Engineer with Messrs. Hobourn Aero Components Co. Ltd., Strood, Rochester.

Mr. J. W. Berry, M.I.P.E., Works Director of Birmingham Aluminium Casting (1903) Company, Ltd., Smethwick, has been appointed Joint Managing Director.

Mr. A. C. L. Browne, A.M.I.P.E., is now Production Engineer with Messrs. B.S.A. Tools, Ltd., Marston Green, Birmingham.

Mr. H. Carleton, A.M.I.P.E., has taken up the appointment of Technical Sales Representative with Francis Motors Ltd., Swansea, on Tilling Stevens and Vulcan Motor products.

Mr. T. R. Clemence, Int.A.M.I.P.E., has now joined Messrs. E. S. Walley & Co. Ltd., Warrington, as Production Manager of their Grass Drier Department.

Mr. H. Hale, A.M.I.E.E., A.M.I.P.E., has left his position of Works Manager with Bradley & Co. Ltd., Bilston, Staffs, and is setting up as a Consulting Engineer.

Mr. R. C. Milton, A.I.P.E., is now Buyer and Material Control Manager at Messrs. Associated Electronic Engineers, Ltd., Stanmore, Middlesex.

Mr. C. M. J. Moatt, A.M.I.P.E., has now become a Director of Blackmill Engineering Co. Ltd., of Macclesfield.

Mr. R. L. Paice, A.M.I.P.E., has been appointed to the Board of Igranic Electric Co. Ltd., Bedford, retaining his present position as Sales Manager.

Mr. R. A. Powley, Int.A.M.I.P.E., A.M.I.W., is now Production Supervisor of all sheet metal fabrication, manufacture and welding at the Pratt and Whitney Aircraft Corporation, East Hartford, Connecticut, U.S.A.

Mr. K. S. Ramaswamy, Grad.I.P.E., has taken up the position of Assistant Mechanical Engineer, Indian Government Railways.

Mr. J. E. Reeve, Grad.I.P.E., has recently taken up the position of Development Engineer with Messrs. R. H. Filmer, Ltd., London.

Mr. E. H. Shaw, Grad.I.P.E., is now Chief Draughtsman with the Birmingham City Transport Department.

Mr. S. F. Steward, C.B.E., M.I.P.E., has recently been appointed Chairman of the South Western-Electricity Board.

Mr. F. Toozs-Hobson, A.M.I.P.E., is now Works Manager of the Saran Engineering Co. Ltd., Marhowrah, India.

Mr. E. C. Willmott, A.M.I.P.E., is now engaged as Principal Technical Officer with The Disabled Persons Employment Corporation, Ltd., London.

BOOKS RECEIVED

"Form Tools" by W. F. Walker, A.M.I.P.E., A.M.I.I.A. Hutchinson's Scientific & Technical Publications. 25s. net.

Prior to the advent of this book, literature on the subject of Form Tools was to be found only as isolated articles in technical journals, or as a short sketchy chapter in a book dealing with relative subjects, or at the most as a tract published by a few manufacturers.

Mr. Walker, therefore, should be commended on having co-ordinated and correlated all this information in such a way, and so producing this timely, useful, and comprehensive volume, which explores the field of Form Tools thoroughly from A to Z.

All aspects of the design and use of Form Tools is dealt with, and undoubtedly will prove of real practical value to Tool Designers and Production Engineers—especially in these days of increasing demands for more and still more production.

There must be wide scope for considerable development in the more extensive use of Form Tools for obtaining maximum machine

efficiency, and this is a case in point where Mr. Walker's book should prove to be a valuable help to the Production Engineer in his search for these applications. — A.A.J.F., M.I.P.E.

"Steel Files: Their Manufacture and Application," by Eric N. Simons. Sir Isaac Pitman & Sons, Ltd. 15s. net.

Here is an admirably printed and illustrated handy book in pleasantly readable form, the alpha and omega (Fig. 1 shows a prehistoric flint rasp) of available information about that ubiquitous tool, the steel file. Literally the book is packed with strictly relevant data, including diagrams, sketches and photographs, of service to everybody at all interested in this subject—and who, at some time or other, does not use a file? Veritably the file-users' encyclopædia.

VISITORS FROM ABROAD

Mr. M. Shaw, M.Eng., Wh.Sc., A.M.I.P.E., who has been visiting the United Kingdom, is Senior Lecturer in Engineering at the University of Melbourne, and has served on the Committee of the Melbourne Section of the Institution for the past three years. He was granted leave of absence by the University Council to study the latest developments and ideas used in workshop research, workshop and production techniques, and modern methods used in metrology.

Mr. M. Shaw.

Mr. C. W. Whitehead

A Graduate Member of the Melbourne Section, Mr. C. W. Whitehead, is visiting the United Kingdom very shortly in order to gain further experience in the production of all types of electric motors and to study production and planning methods in general.

ERRATUM

BROACHING—MACHINES, TOOLS AND PRACTICE
by E. P. EDWARDS, M.I.P.E.

On page 310 of the above paper, which was published in the November, 1946, Journal, there appears the following formula :—

"Pitch $= \sqrt{\cdot 35 \text{ length of cut}}$".

This should of course read :—

"Pitch $= \cdot 35 \sqrt{\text{length of cut}}$".

ISSUE OF JOURNAL TO NEW MEMBERS Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institution.

IMPORTANT In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

SECTION ACTIVITIES
JANUARY—MARCH, 1948.

BIRMINGHAM In January Mr. E. May, A.M.I.E.E., gave an excellent paper on "Developments in Induction Heating," which was well received.

In February Mr. Lewis C. Ord spoke on "Some Measurements of British and American Industrial Efficiency." This paper attracted the record attendance of the session and was well reported in the local press.

The Section Annual Dinner Dance on 21st February was a very well-attended and extremely successful function, the principal guests being Sir Godfrey H. Ince, K.C.B., K.B.E., C.B. (Permanent Secretary to the Minister of Labour & National Service) and Lady Ince. (A more detailed report appears on page 217.)

The Annual General Meeting, at which the officers for 1948-9 were elected, was held in March. Following this Mr. J. Loxham, M.I.Mech.E., M.I.P.E., F.R.S.A., lectured on "Accurate Costing in a Medium-Sized Engineering Organisation."

The Section has co-operated with the Central Technical College and other Institutions in arranging a Lecture Discussion Course on "Measurement of Work and Wages."

The Section Secretary and Committee appreciate the prompt and efficient manner in which Head Office have dealt with the printing and distribution of ballot papers and notices.

BIRMINGHAM GRADUATE The December meeting, at which Mr. T. A. Edwards, H.M. Inspector of Factories, gave an enlightening talk on various aspects of the Factory Acts, was attended by about 50 members and visitors.

In January Mr. Hartford M. King gave a lecture on "Mechanical Handling in Factories," which was well illustrated by slides.

A film show in February on "Taper Roller Bearings" by British Timken Ltd., was very well received. This film was in place of the lecture by Mr. W. H. Lilly, who was unable to fulfil his engagement.

A visit to the Works of British Timken Ltd. took place at the end of February and the party of 30 was extremely well entertained and saw many interesting features.

Mr. J. D. Berry, Grad.I.P.E., was elected to succeed Mr. E. G. Worrall, Grad.I.P.E., as Chairman of the Section at the Annual General Meeting in March. The new Committee was also elected. This meeting was followed by a lecture on " Production and Application of Plastics " by Mr. L. N. Jones of Alfred Herbert, Ltd. Question time was short, but informative, and a large variety of samples were on view.

Altogether this has been a most encouraging quarter and portends even greater activities in the future. Attendance at meetings has varied between 55 and 80 members and visitors.

CALCUTTA

Conditions have greatly improved since last quarter and three meetings have been held since January with arrangements for a further two.

In January Dr. T. R. Gupta, M.I.P.E., gave a very interesting and concise paper on " A Visit to Europe," which was followed by a lively discussion, the speaker answering the questions very efficiently.

Mr. J. D. Scaife, M.I.P.E., gave a paper on " Development of Production Engineering in India " on 26th February, which was greatly appreciated by those present.

In March there was a film show when Mr. Tucker, of Guest, Keen & Nettlefolds, and Mr. J. D. Mookerjee, of Guest, Keen & Williams, were present and answered numerous questions regarding the manufacture of nuts and bolts.

Attendance at meetings could still be better and it is proposed to circulate advance copies of papers to selected members who are particularly interested in the subject so that questions can be prepared on particular points. This should tend to increase interest at meetings as members appear shy of entering into discussion.

The total membership of the Section, including the Graduates and Students, is 70, and it is now necessary for the Committee to meet once a month in order to review the applications for membership. As the membership has increased, it is now possible to insist that the proposer and seconder should be members of the Institution.

At the Annual General Meeting in March, Mr. T. B. Gray, M.I.P.E., was elected President in place of Dr. A. H. Pandya, M.I.P.E. Mr. Gray is a regular attender at the meetings and has shown great interest and worked very hard for the benefit of the Section. Mr. J. Warren-Boulton, A.M.I.P.E., was re-elected Hon. Secretary and a new Working Committee of 7 members has been formed.

Considerable progress has been made and with more members being elected, it is hoped that even more meetings may be held next year.

CORNWALL The following meetings have been held since the last report : on 22nd January a film by Hadfields Ltd., on " Production of High Quality Steel " was shown. In February a talk was given by Mr. E. J. Norris on " Methods of Extracting Lubricating Oil from Crude Stock," which was illustrated by slides. On 19th February a further film was shown on Lubrication, called " The Inside Story," prepared by the Vacuum Oil Co.

The Director and General Secretary was present at the meeting held on 19th March.

The lectures were well attended, the number present being about 80.

COVENTRY GRADUATE On 3rd February, Mr. H. H. Norcross, A.I.P.E., a Consultant in Business Management, gave a lecture on " Industrial Administration."

The last lecture of the season, on 2nd March, was given by Mr. J. V. Collier on " Boot and Shoe Production." Considerable interest was aroused as the subject was different from those usually chosen, and Mr. Collier described in detail the 86 different operations through which a shoe passes during manufacture.

The last event of the session was the Annual General Meeting on 30th March.

DERBY This sub-Section held its Annual General Meeting in March, at which Mr. G. Harrison, M.I.P.E. was re-elected Chairman for the second successive year. Vacancies on the Committee were filled by Mr. W. A. Ford, M.I.P.E., and Mr. Buckland, M.I.P.E.

The Meeting concluded with the showing of sound films on Magnesium. These films were shipped from the U.S.A. specially for the benefit of members of this Institution and the Section would like to thank Headquarters for their trouble in getting these films through the British Customs.

Two other meetings held this quarter were to hear papers read by Mr. G. Chelioti on " The Structure of Management," and by Mr. R. M. Evans on " The Making of a Typewriter."

EASTERN COUNTIES Mr. F. H. Ward, A.M.I.Mech.E., gave a lecture in January on " Preventive Maintenance of Machine Tools " which was well received by members and local Maintenance Engineers, to whom a special invitation had been extended. This was the only lecture of the session dealing entirely with machine tools.

In February, Mr. T. Affleck read a paper by Mr. T. C. Parker, M.I.P.E., on " Cold Upsetting and Thread Rolling," which gave a most interesting insight into bolt production. Those in attendance were most impressed with the excellent slides and film.

The lecture season terminated on 5th March with Mr. Lewis C. Ord's address on " Some Measurements of British and American Industrial Efficiency." The lecture was full of interest and was followed by a lively discussion.

At the Annual General Meeting Mr. M. B. Webster, M.I.P.E., was re-elected President for the ensuing session. Messrs. T. S. Harker, A.M.I.P.E., and P. Wilson, M.I.P.E., resigned from the Committee, the former having been appointed Principal of Wimbledon Technical College and the latter due to pressure of business.

The programme for 1948-9 is in course of preparation.

EDINBURGH

On 28th January Dr. H. Orenstein, M.I.Mech.E., M.I.P.E., gave a lecture on his recent visit to America. The meeting was well attended and an interesting discussion followed Dr. Orenstein's talk.

A meeting has been arranged for 28th April, when Dr. H. B. Fraser will give a paper on " Compromises in Industry."

Arrangements are well in hand for the 1948-9 lecture programme

GLASGOW

The Section meetings have continued to get good support, both from members and visitors.

The two Informal Discussions held have also been well attended, and it has been decided by the Committee to continue this form of meeting next session. The two subjects discussed were " Mechanisation in the Factory and in the Foundry," and " The Human Approach to Mechanisation."

The Programme for next session is now well on the way to completion.

HALIFAX

The lecture programme was continued in the New Year when Mr. Lewis C. Ord presented his paper on " Britain's Industrial Future." The paper was well received by a very large audience and a good discussion followed.

An extra meeting was arranged in January, when three members, who have recently travelled abroad, related their experiences. The speakers and countries dealt with were : Mr. R. W. Asquith, A.M.I.P.E., on France, Belgium, Holland and Poland ; Mr. J. Blakiston, M.I.P.E., on Switzerland, Italy and India ; and Mr. W. P. Eastwood, M.I.P.E., on America, Sweden and Finland.

An interesting discussion followed the reading of the papers, and the photographs and exhibits which were shown all contributed to a most successful evening.

In February, Mr. H. H. Beeny, M.Met., F.I.M., presented his paper on "Cutting Lubricants and Coolants."

The programme for 1948-9 is at present being compiled.

HALIFAX GRADUATE

Three lecture meetings and two works visits have been held this quarter and the Section Committee has met twice.

In December, Mr. W. A. Hawkins, Associate Editor of "The Machinist," read a paper on "Thread Rolling with Cylindrical Dies," illustrated by a short sound film. Fifteen members and visitors were present and a keen discussion followed.

On 22nd January, Mr. H. Glassbrook read Mr. V. W. Pilkington's paper on "The Training of Apprentices," Mr. Pilkington being unable to attend. The lecture was illustrated by slides and a long discussion followed. It was felt that the lecture was of a rather too advanced nature for presentation to a Graduate Section, but members of the staff of the College and training officers of local firms had an interesting discussion with the lecturer during the question time. Thirty-two members and visitors attended.

Mr. Peter Smith, of Frederick Smith & Co. Ltd., gave a lecture on 25th February on "Steel Wire Manufacture," illustrated by diagrams and photographs. Mr. Smith also exhibited two examples of wire drawing dies. This talk was intended to be complementary to the visit arranged to Frederick Smith's Works on 1st March, and succeeded well in this object. A long and informative discussion followed between the lecturer and the 30 members and visitors present.

Twenty-eight members and visitors took part in the visit to Frederick Smith & Co. on 1st March. Practically all sections of the works were in operation and great interest was aroused in the processes seen. Thanks were expressed to Mr. Mitchell, of Frederick Smith & Co., for arranging the visit and showing the party round.

Twenty-four members and guests took part in an evening visit to David Brown & Sons in February. Most of the plant was seen in operation and members spent an interesting and informative evening. Thanks were expressed to Mr. A. Kaye, Training Supervisor at David Brown & Sons, for arranging the visit, and also to the two guides who conducted the party.

There have been two Committee meetings, and it has been suggested that the duties of Secretary shall be split into those of General Secretary and Visits Secretary in the next season.

LIVERPOOL Three lecture meetings have been held since our last report, these being "Materials Handling Equipment" by A. A. Simpson, A.M.I.P.E., in December; "Impressions of a Visit to U.S.A." by Dr. H. Orenstein, M.I.Mech.E., M.I.P.E., in January; and "Production Welding in the Workshop" by A. E. Griffin, M.Inst.W., in February. The attendances were 66, 65 and 75 respectively.

Membership is now 107 and applications continue to flow in at a gratifyingly high rate, over 40 having been submitted to Council to date.

The Committee and members of the Liverpool Section are particularly pleased by the decision of Council at its last meeting to grant them full Section status. This honour is much appreciated and will undoubtedly reflect to the ultimate benefit of the Institution as a whole. The Committee is hoping that the necessary Inaugural Meeting shall be held in September next as a fitting opening to a new season's activities.

Preparations for next season's lecture programme are already well advanced.

LONDON The Annual General Meeting was held in March. Against the Section Committee budget for an expenditure of £100 to cover the cost of the Section activities, £97 has been spent in 8 months. There will be, therefore, an excess of expenditure over budget at the end of the season. This is accounted for by the fact that the lecture meetings have taken place at the Royal Empire Society and not, as previously, at the Institution of Mechanical Engineers. This change has been made because the time restrictions imposed by the Institution of Mechanical Engineers limited the attendances. At the same time the members enjoy the less formal atmosphere and the facilities for refreshments at the Royal Empire Society rooms.

The strength of the London Section at 1st July, 1947, was 1,576, and this has risen to 1,663 as at 1st March, 1948. It is felt that although there is a steady increase, an effort should be made to expand more rapidly, particularly in the senior grades of membership.

The lectures organised by this Section were planned to provide a balance between the managerial and technical aspects of Production Engineering. They were well received and created a great amount of interest. The subjects dealt with were: "The Gap Between the Production Engineer and the Manager," "Efficiency of Machining as a Basis of Production," "Inspection," and "Management Problems in a Small Firm." Attendances have been at a high and satisfactory level (between 200 and 250), which is higher than for previous years.

It is understood that the Finance and General Purposes Committee are recommending the formation of the Reading Sub-Section to Council, whose decision is awaited.

Arrangements are being made for members to visit one or two factories of special interest.

As Government regulations did not then permit the holding of the Institution's Annual Banquet, the London Section was asked by Council if the presentation of the Institution Medals and the Lord Austin Prize Award could be made at one of their meetings. The London Section Committee were delighted with this honour, and special arrangements were made for the prizes to be presented at the meeting on 8th April, 1948. Invitations were extended to the President, the Chairman of Council, Section Presidents, Chairmen of all Standing Committees and the Director and General Secretary.

Mr. F. P. Laurens, O.B.E., M.I.P.E., has been re-elected as President for the coming season, and Mr. H. W. Townsend, M.I.P.E., has been elected Hon. Secretary.

LONDON GRADUATE

The first meeting of this quarter was held in January, when Mr. E. A. Gordon, B.Sc., A.M.I.P.E., gave a lecture on "Production Incentives." This led to an extremely interesting and lively discussion.

The February meeting was addressed by Mr. G. Callis, B.Sc. (Tech.), F.I.M., who spoke on "The Engineer and The Metallurgist."

The factory visit programme was continued with a visit to the plant of Standard Telephones & Cables, Ltd.

The Committee consider that satisfactory progress has been made.

LUTON

The lectures of the Section have not been supported as well as those of the previous sessions, and it is felt that this is mainly attributable to lack of adequate transport facilities.

The papers have been of an interesting nature and very well received by those attending.

Arrangements are well in hand for a Joint Conference to be held on 30th April and 1st May in conjunction with other Institutions in Luton.

MANCHESTER

Two very interesting visits have been made recently which were of a totally different type. The first was to the Lancashire Steel Corporation, where members saw all operations from the blast furnace to the rolled steel sections. The second visit was to the works of Courtaulds Ltd., where the many processes were seen.

The lecture in January by Mr. G. E. Windeler, on " Mechanical Mishaps and their Relation to Design and Workmanship " was extremely practical. It was very well received by a large audience and it was also greatly appreciated when repeated at Crewe.

Mr. R. K. Allan, M.I.P.E., a member of Council, gave a most useful paper in February on " Rolling Bearing Application," which was followed by a good discussion.

The Annual General Meeting on 24th March was followed by a paper on " Production of Flat Surfaces."

MANCHESTER GRADUATE

The meetings during the last quarter have embodied a film on " Metal Spraying " by Mr. W. E. Ballard, F.R.I.C., F.I.M., and a lecture on " Hydraulics and Their Application to Machine Tools " by Mr. H. C. Town, M.I.P.E. These were well attended and were followed by lively discussions indicating the interest shown.

Interesting visits have been made to the Greengate & Irwell Rubber Works, Taylor Bros.' Steel Works, and the Tool Works of Kendall & Gent.

Mr. H. G. Baron gave a lecture on " Heat Treatment " following the Annual General Meeting on 8th March.

The 1948-9 programme is now being formulated and every endeavour will be made to maintain the high standard of previous activities.

MELBOURNE

It is with extreme regret that we report the death of the Section President, Mr. M. T. W. Eady, M.I.P.E., Managing Director of McPhersons Pty. Ltd., and President of the Australian Sub-Council.

Mr. Eady was a pillar of strength in the Institution in this country and performed valuable service in the formation of the Melbourne Section.

Mr. E. B. Richardson, M.I.P.E., has been elected in his place.

Mr. Mansergh Shaw, A.M.I.P.E., Senior Lecturer in Engineering at the Melbourne University, is visiting Europe to study modern workshop research in England and on the Continent.

Mr. J. A. Stewart, Production and Tool Engineer of McPhersons Bolt Works, gave an interesting lecture on February 11th on " Production of Machine Forgings."

N. IRELAND

At a meeting in January, at which members discussed ways and means of stimulating interest in the activities of the Section, it was decided that those present should endeavour to introduce new members. The officers for 1948-9 were elected, and Mr. J. C. Breakey, M.I.P.E., is now to be President.

In February, Miss A. Shaw, M.A., M.I.P.E., gave a most interesting and instructive lecture on " Motion Study " which was supported by films and lantern slides.

It is hoped that it will be possible to have at least one more lecture this session.

NOTTINGHAM

Three meetings have been held this quarter, the March meeting being devoted to the election of officers for next session. Mr. J. H. Bingham, M.I.P.E., was elected as Section President.

As stated in the last report, the new departure in the proceedings at lecture meetings still continues to attract both members and visitors, and attendances have increased.

On March 9th, 1948, a party visited the factory of The Metal Box Co., Ltd.

The April meeting was held in Nottingham with a discussion on " Inspection."

PRESTON

Since the last report there have been three lectures, the Winter programme now being completed. In January, Messrs. Zandstra and Pinkney, of Philips Electrical Ltd., gave a two-fold lecture on " Induction Heating " from the theoretical and practical sides respectively.

In February, Mr. A. J. Charnock, M.I.P.E., a member of the Preston Section Committee, gave a most interesting report on his visit to the United States, entitled " U.S.A. Today " before a large audience. As several of his audience had also only recently returned from America, a most lively and instructive discussion ensued.

In March, Mr. T. G. Rose, M.I.P.E., gave an informal talk on " Control of Overhead Costs " which was fairly well attended in spite of fog.

In December, to our very great regret, we lost the services of Mr. S. M. Hardaker, an enthusiastic member of the Committee. Mr. Hardaker came from Glasgow about five years ago, and has now gone to live in Dudley.

At the Annual General Meeting in February, Officers for the ensuing session were elected, Mr. T. A. Westall, M.I.P.E., being elected as President.

SHEFFIELD

The January meeting took the form of an open discussion on the advantages and disadvantages of Hydraulics as applied to modern machine tools. Most of the members and visitors present took part in the proceedings.

On 11th February, a large gathering heard a very able lecture

by Mr. H. Richards on "Wire Drawing and Wire Drawing Machinery." The lecturer's comparisons of current British and American practice were of great interest to the audience.

The informal meetings in December, January and February have attracted a small but very enthusiastic number of members. Subjects for discussion are plentiful, and although it is not intended that these meetings should be crowded, a few more members could be accommodated.

SHREWSBURY

Mr. J. H. Wilkinson, A.M.I.P.E., gave a lecture in January on "Future Development of Machine Tool Design," which proved to be very interesting. There was a good attendance and the discussion which followed was mostly concerned with special machines for grinding operations.

The lecture in February, "Fundamentals of Fine Measurement," was given by Mr. J. Loxham, M.I.Mech.E., M.I.P.E., F.R.S.A. This was very interesting and informative and was given before about 60 members and students from the Walker Technical College. This particular branch of engineering obviously has a wide appeal and Mr. Loxham was heartily thanked by the Chairman and the Principal of the Walker Technical College for the way in which he had so clearly explained the methods and working of the extremely sensitive instruments used and demonstrated.

A further lecture was held in April on "A Report on Management Methods" by Mr. Lewis Clayton, M.I.P.E.

S. AFRICA

Approximately 60 members and guests were present at the first meeting of the quarter in February to hear Mr. E. K. Wilde deliver a paper on "Time and Motion Study," a science comparatively in its infancy in this country. A lively and interesting discussion ensued.

Thirty members and guests attended a "Problems and Discussions" evening in March.

The Annual General Meeting and Dinner on 9th April was held at one of the larger hotels in Johannesburg, and approximately 100 members and visitors attended.

SOUTHERN

We are pleased to report that the Section Programme has continued to maintain a high standard of attendances and that the subjects presented have been of appeal to members and visitors.

The attendances at the last three lectures have been extremely good and as a result of these meetings sixty enquiries regarding membership have been made.

The Section was pleased to welcome the Director and General

Secretary to the February meeting, and his remarks made a profound impression on all present. The Director and General Secretary also attended the Annual General Meeting in March.

An invitation from Wing Commander T. R. Cave-Brown-Cave, C.B.E., M.I.P.E., Professor of Engineering, University College, Southampton, resulted in a visit to the College by the Institution's Education Officer, who met the Departmental Heads and Lecturers in the Production Engineering Section.

SOUTH WALES AND MONMOUTH-SHIRE

The Director and General Secretary of the Institution was present at a very interesting lecture delivered to the Section in January by Dr. E. J. B. Willey, on "Some Applications of Electronics in Industry."

The Section President, Mr. Guy L. Norman, O.B.E., M.I.P.E., presided, and there was a large gathering at the Institute of Engineers, Cardiff. Dr. Willey's excellent lecture was very much appreciated, and some interesting practical demonstrations of the latest electronic devices were witnessed. The Director and General Secretary proposed a vote of thanks to Dr. Willey and gave a short address. He reviewed the progress of the Institution and gave a brief outline of the hopes he held for the future as well as mentioning the forthcoming Bournemouth Convention.

The Section Officers and Committee were the guests of the Section President at a dinner held at the Park Hotel, Cardiff, on 4th March, when the President was thanked for his very active participation in the affairs of the Institution during his term of office. The Committee was of the opinion that the Section was now making good headway after the dislocation caused by the transfer of members due to the re-organisation of industry at the end of the war.

The Section hopes that Council will approve the formation of a West Wales Sub-Section at Swansea, preparations for which are well advanced.

Arrangements have been made for the interchange of works visits between the Western Section and the South Wales Section.

WESTERN

The Winter Session has been very satisfactory. Attendances at meetings have shown a great improvement on those of recent years, and the increase in membership has been of gratifying proportions.

Since the last report three lecture meetings have been held in Bristol. Mr. F. Nourse gave a paper on "Various Aspects of Inspection of Production," at which there was a record attendance; Dr. H. Orenstein, M.I.Mech.E., M.I.P.E., of Glasgow, spoke on "Recent Developments in American Production Engineering

Practice" ; and Mr. R. L. Tandy, A.M.I.Mech.E., A.M.I.P.E., presented his lecture on "The Manufacture of Ball and Roller Bearings." The Annual Section Meeting was held in March.

In addition, a further lecture meeting was held in Swindon, where Mr. R. O. Jeakings gave his paper on "Jig and Tool Design," which was enthusiastically received and was followed by a keen discussion until a late hour. It is very gratifying to record the support given to meetings in centres other than Bristol. The success of these meetings naturally depends upon a good attendance of visitors, and results have more than repaid the time and effort put into them.

Regional co-operation is being pursued, and one result will be an exchange of visits during the forthcoming summer with our nearest neighbour, the South Wales Section, who will probably visit the Bristol Aeroplane Co. in May, and the Western Section will, it is hoped, visit one of Guest, Keen & Baldwin's Steel Mills in South Wales in June.

At the Annual Section Meeting, recently held, it was decided to combine the office of President Elect with that of the Vice-President.

WOLVERHAMPTON

Since the last report we have had regular monthly lectures by prominent engineers, and these have been held in Wolverhampton with an average attendance of 40 members. The papers have been of excellent standard, and lively discussions have followed each paper.

The Committee dealing with the P.M.H. Conference to be held at Wolverhampton on 22nd May, have almost completed the arrangements. We are fortunate in having excellent speakers from the U.S.A. and Belgium, and these, together with prominent speakers from both H.M. Government and Industry, should make a valuable contribution towards increased productivity.

Owing to ill health and pressure of business, Mr. W. Bainbridge has resigned from the Presidency. The Vice-President, Mr. A. J. Aiers, M.I.P.E., has been elected in his place.

WOLVERHAMPTON GRADUATE

There have been three lectures this session on "Thread Rolling," "Metallurgy," and "Education," which were well attended.

Two visits have been made, one to the Wolverhampton Telephone Exchange, and the second to the Lilleshall Steel Mills.

Lectures have been arranged up to June, 1948, and Works Visits to December, 1948.

The Committee now consists of 14 members drawn from all districts. In order to relieve the Hon. Secretary of much of the

routine work, Honorary Secretaries have been appointed to arrange Lectures and Works Visits. The Committee report that their first lady member has been admitted.

The Section is in a very healthy state and forging ahead with a well filled future programme.

YORKSHIRE

Three lectures have been held since the last report. In January, 1948, Mr. F. Hickling, M.B.E., M.I.A.E., delivered a lecture on " Ball and Roller Bearings."

In February, 1948, Mr. H. de G. Gaudin, B.A., A.M.I.Mech.E., gave a very interesting talk on " The History and Development of the Automatic Loom." Everyone agreed that this was a most interesting lecture.

Mr. F. T. Nurrish, M.B.E., M.I.P.E., gave a lecture in March on " Eighty-five Years of Precision Production Engineering," which was very well received by over 100 members and visitors.

In connection with this lecture, 48 members visited Geo. Bray & Co., Ltd., to see the methods of production as outlined in the lecture. It was a most interesting and instructive experience.

This lecture was preceded by the Annual General Meeting at which Mr. W. Armstrong, M.B.E., M.I.P.E., was re-elected President for the 1948-9 session. The new Committee was also elected.

YORKSHIRE GRADUATE

This quarter has been a very successful one, and attendances have been very good indeed. Interest in the Section is growing, and if the present enthusiasm is maintained we can look forward to a most successful future.

On 13th December, 1947, there was a most instructive and interesting visit to Woolley Colliery which was well attended. The party was conducted throughout the workings underground and saw the machinery utilised in the production of coal.

At the Committee meeting in December, 1947, the resignation of Mr. J. B. Clayton from the office of Hon. Secretary was accepted, and Mr. W. R. Walton was appointed in his place.

A most successful meeting was held on 17th January, 1948, at which Mr. R. E. Ketley, M.I.Loco.E., read an excellent paper on " Diesel Rail Traction."

Another well attended visit was paid to the works of Jowett Cars Ltd., the machine shop layout being found particularly instructive.

At the meeting in February, an excellent paper was given by Mr. J. J. P. Mackenzie, B.Sc., M.I.Mech.E., on " Engineering and the Steelmaker," which was followed by a film of Hadfields Ltd. on " The Production of High Quality Steel." Every stage in the production of steel was dealt with, and the film helped to clarify points which were not so obvious from the paper.

SECTION MEETINGS

The following meetings have been arranged to take place in May and June, 1948. Where full details are not given, these have not been received at the time of going to press.

May

1st HALIFAX GRADUATE SECTION. A Luncheon and the Annual General Meeting, followed by a lecture and sound film on "The Manufacture of Gas Turbines" by Mr. L. H. Leedham, M.I.P.E., M.I.Mech.E. (Ministry of Supply National Gas Turbine Establishment, Whetstone) will take place at the White Swan Hotel, Halifax, at 2-30 p.m.

5th NOTTINGHAM SECTION. A lecture on "Metal Finishing" will be given at the Victoria Station Hotel, Milton Street, Nottingham, at 7-00 p.m.

6th SOUTH WALES & MONMOUTHSHIRE SECTION. A Visit to the Bristol Aeroplane Company has been arranged, leaving Cardiff at 10-30 a.m.

11th WOLVERHAMPTON GRADUATE SECTION. A lecture on "Fine Measurement" will be given by Mr. L. Wilcox, M.Sc., M.I.E.E., at the Wolverhampton & Staffordshire Technical College, Wolverhampton, at 7-15 p.m.

12th WOLVERHAMPTON SECTION. A lecture on "Metallurgical Factors influencing Machinability" will be given by Mr. L. W. Johnson, M.I.P.E., at the Wisemore Schools, Walsall, at 7-00 p.m.

15th YORKSHIRE GRADUATE SECTION. The Annual General Meeting will take place at the Great Northern Hotel, Leeds.

22nd WOLVERHAMPTON SECTION. An all-day Conference on Production per Man Hour will be held at the Wolverhampton and Staffordshire Technical College, by kind permission of the Governors. The proceedings will be opened by the Mayor of Wolverhampton, and addresses will be given by Major J. Freeman, M.P., Joint Parliamentary Secretary to the Ministry of Supply, on "The Importance of P.M.H. to the Nation"; M. Robert Caussin, of Belgium, on post-war recovery; Miss A. G. Shaw, M.A., M.I.P.E., on "Motion Study; and Mr. J. Y. Scott, President of the Van Norman Machine Tool Works of America and a member of the A.S.T.E. The concluding address will be given by Mr. N. Rowbotham, C.B.E., M.I.P.E., President of the Institution.

May—*cont.*

27th SHREWSBURY SUB-SECTION. A lecture on " Powder Metallurgy " will be given by Mr. H. Greenwood.

June

3rd HALIFAX GRADUATE SECTION. A visit has been arranged to Cammell Laird's, Birkenhead, arriving at 2-00 p.m.

8th WOLVERHAMPTON GRADUATE SECTION. A Film Show, " Wheels Behind the Wheels," has been arranged to take place at the Walsall Technical College at 7-15 p.m. Mr. P. Latham, of the Universal Grinding Wheel Co. Ltd. will be present to answer questions.

THE APPLICATION OF THE PHOTOGRID TECHNIQUE TO DRAWING PROBLEMS*

by KENNETH L. JACKSON, † M.Sc.(Eng.),
A.M.I.Mech.E., A.I.I.A., Grad.I.P.E.

Recent experiments which were undertaken by the author have shown that the use of the photogrid, in determining the qualitative and quantitative plastic strains incurred during the drawing of sheet metal, is justified because of the comparative simplicity of the apparatus required. Measurements have been taken of the radial and hoop strains in the case of circular single stage draws for varying reduction ratios, and some very interesting results were obtained.

PROCEDURE FOR THE PRODUCTION OF PHOTOGRIDS

The apparatus required consists of (*a*) a suitable fine grain negative graticule, (*b*) a simple horizontal centrifuge capable of speeds up to 500 r.p.m., (*c*) a lighting unit equivalent to a 500 Watt Osira mercury vapour lamp, (*d*) a supply of special emulsion, and (*e*) a solution of methyl violet in water. It is an advantage to have a vacuum printing frame as used in ordinary photographic work, but it is not absolutely essential, as good contact between the graticule and specimen is possible by using a heavy slab of plate glass.

GRATICULES

These may be in the form of quarter-plate negatives with rectangular or polar co-ordinates as are required, and the spacings may be any convenient amount such as squares of 0.100 in. sub-divided into 0.010 in. squares in the case of the rectangular co-ordinates, or lines radiating at intervals of one degree with circumferential lines spaced at 0.010 in. in the case of the polar. The prime factor is that the lines should be consistent in thickness and be not more than one-fifteenth to one-twentieth of the spacings, and that the spacings themselves should be consistent.

CENTRIFUGE

A small motor (about 0.5 h.p.) arranged with its spindle vertical, the latter carrying an open wooden box with sides of about 3 in. deep, will suffice. Specimens may be kept in position in the box by means of drawing pins. It may be expedient to make use of a rheostat in order to have a range of speeds for different sizes of specimens.

* Modified extract from thesis for the degree of M.Sc.(Eng.) in the University of London.

† Faculty of Engineering, University College, London.

ILLUMINATION A lighting unit consisting of a 500 Watt Osira mercury vapour lamp fitted with a suitable condenser, and arranged to give an evenly distributed illumination over the graticule at a distance of about 9 in. from the source, has proved successful.

EMULSION This may be made up as follows :—

Procene photo-engraving glue	...	8 oz.
Ammonium Bichromate	...	1 oz.
Water		11 oz.

8 oz. of glue are mixed with 7 oz. of water, and 1 oz. of Ammonium Bichromate is dissolved into 4 oz. of water. The two solutions are then added together and allowed to stand for about two hours before use. It should be kept away from strong light, and in a cool place. A few drops of ammonia solution will help to prevent putrefaction if the solution is to be stored for a considerable period.

DYE AND PROCEDURE In order to make the photogrid clearly visible after exposure, it is necessary to dye it, using a solution of methyl violet in water (two per cent. by weight). The specimens are prepared by scrubbing the surface with powdered pumice and water, using cotton wool. They should be made larger in size than the finally required shape, as the emulsion tends to build up at the edges, during whirling in the centrifuge. After cleaning and scrubbing the specimen is then washed in cold water and placed into the centrifuge, and the thin film of water will help the emulsion to spread rapidly. A small quantity of emulsion (about 1.5 c.c.) is then poured on to the plate and the centrifuge set in motion. It has been found that the best results are obtained at speeds of 400-450 r.p.m. After whirling for three minutes the specimen is removed and allowed to dry for a further ten or fifteen minutes, and is then placed together with the graticule and glass block, into position below the lighting unit. Exposure should be six minutes, within half a minute. Finally the specimen is washed thoroughly in cold running water in order to wash out the soft unexposed film, and then placed into the dye solution for a period of two minutes, followed by re-rinsing in cold water and allowed to dry at room temperature.

PRESSING PROBLEMS In the case of rectangular draws, the type of grid which may be used is illustrated in Fig. 1, and the distribution after drawing is indicated in Fig. 2. It is obvious that unusual forming operations may be solved by similar grids, and the blank profile may be measured or read off directly from the formed part, since the original spacings are known. These readings are then transferred back to another unformed specimen with the

same photogrid pattern, and the true blank profile thus ascertained. An important advantage is that the effect of different materials or thickness of stock is automatically accounted for, and that each job may be considered as a unique one. However, firstly it is necessary to cut the blank to within reasonable limits of the anticipated profile in order to avoid excessive local drawing effects. It is hoped that the photogrid technique will become widely used, as the business of making successive templates is avoided, and the method is at least putting blank profile determination on to a scientific basis. Trial and error have reigned too long !

(Illustrations referred to in this Paper appear on page 240.)

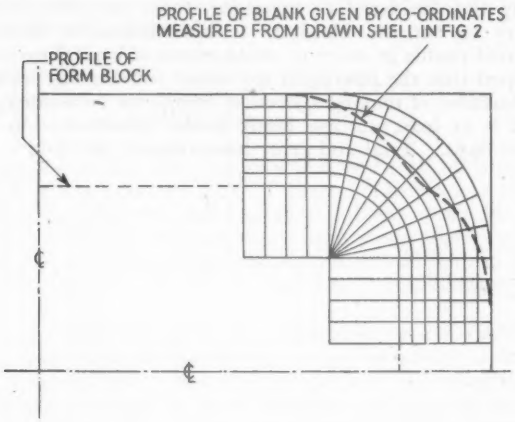

PROFILE OF BLANK GIVEN BY CO-ORDINATES
MEASURED FROM DRAWN SHELL IN FIG 2
PROFILE OF
FORM BLOCK

FIG. 1.

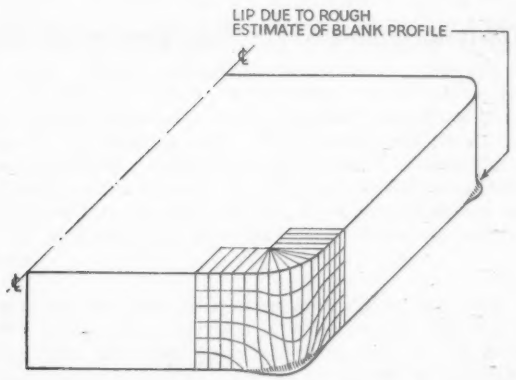

LIP DUE TO ROUGH
ESTIMATE OF BLANK PROFILE

FIG. 2.

MODERN MINING MACHINERY

by J. W. L. ANDERSON, B.Sc.

Presented to the Coventry Section of the Institution of Production Engineers, December 12th, 1947.

It is particularly pleasing to give a paper of this description in Coventry since the Warwickshire coalfield has always been to the forefront of mining development. It is true to say that the surface layout at Keresley Colliery has, for many years, served as a model, whilst the layout of Pooley Hall Colliery was outstanding when first completed, and the colliery village at Arley was also of particular interest when built some years ago.

The subject "Coal Mining Machinery" has received much publicity in recent years, but the facts usually represented to the public do not give a very true picture of the general position. The mining machinery industry is by no means new, as will be appreciated when it is realised that British Jeffrey-Diamond Ltd. celebrates its fiftieth anniversary this year.

The type of mining equipment developed in this country has been evolved to line up with British mining conditions and systems of work, and, therefore, differs in many respects from equipment designed and produced in other countries, such as the United States.

The mining of coal in Great Britain has been carried on over hundreds of years, with the result that the shallow seams have been extracted, for the most part, and in many cases the higher quality seams have been won. Consequently, British mining engineers are continually being called upon to cater for the production of coal from deeper and deeper seams, and in many cases difficult geological conditions have to be met and overcome.

As indicated above, mechanisation of our mines has been in progress for many years and the latest official published figures show that 72 per cent. of our coal was machine cut and 71 per cent. mechanically conveyed in 1945. Since that date, of course, considerable progress has been made in mechanisation, and it is fair to assume that the present-day figures will show a substantial increase over those quoted.

MAIN SYSTEMS OF COAL MINING

Two main systems of winning coal are employed in this country — the "longwall" and "room-and-pillar," the majority of our coal being cut by the "longwall" method. In this system, total extraction of the seam is aimed at, and the length of face varies according to the seam thickness, gradient, and other factors. The

average length of a single-unit face may be taken as approximately 130 yards, but generally two faces are operated together, the coal being loaded out from the face conveyors along what is termed a gate conveyor, to a central loading point (Fig. 1). In many instances, a series of double-unit faces are developed simultaneously, and, generally speaking, in step with one another, the output from these units, or panels, being collected by gathering conveyors and discharged into pit tubs at one loading point. In the longwall system mentioned, the coal is generally undercut by machines to an average depth of 5 feet, and this depth of coal is usually stripped off from the face every 24 hours.

It is the usual practice to devote one of the three shifts in every 24 hours to filling the coal. The work of cutting, moving forward and extending the face and gate conveyors and other necessary work on the face, together with the making of adequate roadway height for travelling, is done on the remaining two shifts. In this system, each man has a definite job of work to do which occupies him through the full shift time, and it is most essential that all operations are completed to a time-table, otherwise interruption of the cycle will occur and output will be lost. From this it will be appreciated that reliability, both of the cutting machines and conveying equipment, is of primary importance.

In the old days, the coal seam was undercut by means of hand-picks, and this was certainly most skilled and arduous work. As the coal was undercut in this way, it was supported by wooden "sprags" which were ultimately withdrawn and the coal fired by means of explosives (Fig. 2). This class of work was the first to receive consideration by the engineer, and the modern coal cutter is the result of continual effort by engineers in this connection.

OPERATION OF LONGWALL CUTTER

At the present time, longwall coal cutters consist of three units—a centrally-located power unit (electric or compressed air), a haulage unit, and a cutting end. These are shown clearly in Fig. 3. Undercutting is done by a chain which carries a series of picks, the cutting member being free to swing about the cutting end casting. Before starting to cut, the machine is placed alongside the coal face (Fig. 4). The cutting member or jib is then pulled into the coal under power, cutting as it goes (Fig. 5). For hauling the machine along the face, a steel rope is provided at the haulage end which is attached at its free end to a prop set between the roof and the floor. As the rope drum in the haulage end revolves the rope is wound up and the machine, therefore, travels along the face. Undercuts of 6 ft. 6 ins. have been taken successfully in this country, but generally speaking the roof conditions do not allow of such a depth, and, as mentioned previously, the

average depth of undercut would be about 5 feet. The width of the undercut is generally about 6 ins., and where the cutting medium is not too difficult, rates of advance of 5 feet per minute are quite common. The machine illustrated in Fig. 3 has a length of 8 ft., height of 15 ins., and width of 2 ft. 2 ins. It is powered by a 60 h.p. one-hour-rated electric motor, or a 60 h.p. compressed air turbine.

In order to maintain a clean cut under the coal, it was formerly necessary for a man to shovel away the cuttings immediately behind the cutting member or jib. It was found that with the newer designs of coal cutter it was impossible for a man to keep pace with the machine, and therefore some mechanical appliance had to be designed to clear the small cut coal or " gummings " from the chain. Such a device, known as a " Gummer," is shown attached to the cutting end of the machine in Fig. 6, and by its use, 75 to 80 per cent. of the coal cuttings are deposited behind the machine. Maximum advantage may be taken of the resulting clean undercut by the firing of shots to bring down the coal. Moreover, the arduous work of cleaning out the undercut by hand is now a thing of the past where efficient gummers are employed. The quantity of material handled by the gummer may be judged from Fig. 7. Incidentally, much power is saved by the use of a gummer due to the fact that power is not absorbed by the churning of coal in the undercut. It is fair to say that 25 per cent. saving in power may be achieved by the use of a gummer under normal conditions.

For longwall duty, coal face conveyors may be of three different types—shaker, belt and scraper chain. Shaker conveyors are still perhaps the simplest type of conveyor, but their application is limited to gradients in favour of the load. The length of a shaker would not generally be greatly in excess of 100 yards and the maximum horse-power employed is about 22.

TYPES OF CONVEYORS

Scraper chain conveyors were also one of the early types, the Blackett conveyor brought out in 1904 has done some excellent work and many of these conveyors are still in use although the original design has, of course, been greatly improved. Over the past year or two a very increased interest has been shown in scraper chain conveyors for face duty and new designs have been evolved. Conveyors of this type are now running up to lengths of 150 yards and in some instances to even greater lengths where the gradients have been substantially in favour of the load. The unit illustrated in Fig. 8 is capable of handling 90 tons per hour on level conditions at a length of 100 yards and is powered with a 25 h.p. motor. Another interesting variation is shown in Fig. 9. This application is designed for use when the face gradient is favourable to the load and the drive head is located at the top of

the slope. This means that a minimum of tension is required in the coal carrying chain and such a conveyor, therefore, lends itself particularly well to undulations which may occur on the coal face. Scraper chain conveyors are particularly valuable when damp conditions are prevalent as the drive is absolutely positive and slipping cannot occur as it does in the case of a belt conveyor.

Belt conveyors are commonly used on the coal face and have given a good account of themselves, although operational costs tend to be high and the cost of replacement belting is heavy due to the arduous nature of the work which the conveyors are called upon to perform. A good example of a medium-powered face conveyor is shown in Fig. 10, and it will be noted that the motor is built in to the gear-head so that the minimum of room is required by the driving unit as a whole. The overall dimensions of such a gear-head are—height to top of jib drum 14 ins., length 5ft. 4 ins., width 3 ft. 2 ins. The gear-head will accommodate belting up to 26 ins. in width and will handle an output of 80 tons per hour when fitted with 26 in. wide belting. The length, of course, will depend upon capacity and gradient. Considerably larger belt units are available with a maximum face horse-power of about 45. Such applications, generally speaking, will be for thick seam work.

For transportation of the coal from the face conveyors to the point where the pit tubs are loaded, belt conveyors are generally employed. The width and horse-power of these units varies considerably according to the duty, and the main gathering installation may be equipped with 42 in. belting operated by drive heads of up to 200 h.p. It may be mentioned at this point that between the gate belt and the face conveyors it is becoming common practice to insert a short chain conveyor either independently driven or driven from the tail drum of the gate belt. The idea behind this is to minimise the wear and tear on the belting of the gate conveyor. This is achieved by delivering coal on to the gate conveyor at approximately the same speed and in the same direction as the gate conveyor belt.

"ROOM-AND-PILLAR" METHOD

The second main system of mining is that known as "Room-and-Pillar" and this method was first developed in this country many years ago. Some mines, particularly those in the north-eastern coastal district, have always operated this system.

Generally speaking, room-and-pillar mining entails partial extraction of the coal seam only, and from an economic standpoint this is unsatisfactory in Great Britain as our coal resources are comparatively limited. The system can, however, be worked with considerable advantage where the seams are relatively shallow and mining has to be done under a densely populated area, as the coal

left untouched provides support, and surface subsidence and dislocations due to mining can be greatly reduced or virtually eliminated. In other cases, too, heavily-watered strata may be found between the coal seams and the surface, and naturally it is then desirable that no dislocations of the strata should occur, which might cause inrushes of water or heavy pumping loads. This implies in effect that by the use of partial extraction systems on the room-and-pillar methods, it is frequently possible to work areas of coal which could not be worked at all by normal longwall methods without very heavy additional operating costs and thus a certain tonnage of coal is won to our economic advantage.

Where the geological conditions are suitable, it is possible to operate the room-and-pillar system with total extraction, but in this country such conditions are comparatively few and far between, and even in the United States, where general physical conditions are greatly superior to our own, experience shows that the cost of production per ton in total extraction by room-and-pillar methods is definitely greater than the production costs on partial extraction systems.

The great advantage of the room-and-pillar system is that dead work is reduced to a minimum, and it is frequently possible to work out an area without having to take additional height in the main headings, the reason being that the ground movement is less on the partial extraction basis and the rate of advance of the coal face in comparatively narrow places is great compared with the normal longwall system.

During the war considerable attention was given to room-and-pillar operation as it was then felt that the output per man shift could be increased by the maximum use of mechanisation and unproductive work could be reduced to a minimum. It was appreciated that a percentage of the available coal would be left unworked, but as output was the primary consideration, this method offered attractions under the emergency conditions then prevailing.

The Americans, many years ago, adopted the room-and-pillar system and developed machinery designed to operate this system to the best advantage, and during the war years considerable quantities of American plant were supplied under Lease/Lend for the operation of this system in this country on an emergency war-time basis.

The mining industry has learned by experience the types of American plant which are most suitable for use in this country, and such plant is now manufactured in Great Britain.

Mechanical, self-propelled loaders have been applied in this country, in many cases with considerable success, where conditions of height, roof and gradient have been satisfactory, as have also self-loading shaker conveyors. Generally speaking, however, it

has been found that the most satisfactory type of equipment has involved the continued use of hand-filling on to specially-designed scraper chain conveyors. Such plant is most versatile and corresponds most nearly to that with which our colliery people are familiar.

Coal cutting is almost universally employed with such systems, but the type of machine differs from that generally used for longwall practice. The design of coal cutter in question is called a " Shortwall " machine—Fig. 11. In this type the cutting member or jib is rigidly attached to the body of the machine and does not swing as is the case with the longwall unit. The reason behind this design is that a machine of this description can cut straight under the coal in a comparatively narrow heading, forming a square corner, and the machine can then travel sideways across the working place and at the end of the cut be withdrawn, forming a second square corner. This not only means a saving in time but also simplifies the question of shot-firing and cleaning out of the corners of the working-place. With this arrangement, however, the width of the machine is disproportionate to the longwall unit. As roof conditions are generally more favourable, this is not usually of great moment, but it explains why a shortwall machine is not applicable, generally speaking, for longwall working. The shortwall machine is controlled by two ropes, one of which hauls the machine across the face whilst the second controls the angle of the machine relative to the coal face.

THE JOY LOADER The Joy Loader was introduced into this country many years ago, primarily for development work owing to its capability of handling rock as well as coal, and where the seam height permitted and other conditions were suitable, the Joy Loader aquitted itself very well. Briefly, it consists of an electrically-operated, caterpillar-mounted machine, having two gathering arms which collect the coal after it has been blasted down by explosives, and pass it to a swinging boom conveyor of the chain type, which then delivers it either on to a scraper chain conveyor or into a battery-operated, rubber-tyred shuttle car. Such cars operate between the loading machine and the pit cars, or, alternatively, deliver on to a gathering belt conveyor.

For development work the types of equipment used for room-and-pillar mining are particularly applicable, and this plant has been, and is being, extensively used for driving the necessary headings prior to longwall operation. Fig. 12 shows a typical development heading involving the use of chain conveyors and a shortwall coal cutter. In this system, the necessity of taking additional height in the roadway for ease in travelling, etc., has been covered and the arrangement is such that heading in the coal is carried on at the

same time as the additional travelling height in the roadway is being made. The stone obtained in this operation is packed at the sides of the roadway in the area where the coal has been extracted, and this system therefore has the further advantage that it is generally unnecessary to bring any stone out of the pit from the development places. Furthermore, it is possible to prepare longwall production faces as the heading advances so that the minimum time elapses before main production is possible.

The system utilised here, so far as the coal winning is concerned, is similar to that successfully applied in normal room-and-pillar practice, and the plant and the system are worthy of some attention.

The shortwall machine indicated in the diagram has already been described, the conveyor shown at the face of the heading is illustrated in Fig. 13. This conveyor is light, yet robust, and is so designed that it can be drawn tight up against the coal face after undercutting, and the shots are then fired in the coal ensuring as large a percentage of the coal as possible being blown on to the conveyor (Fig. 14). The face conveyor discharges on to a further scraper chain conveyor, which is specially designed for ease in extension and thence along a cross conveyor of the scraper chain conveyor type which delivers on to the permanent belt conveyor in the gateway. The purpose of the circuitous route of the coal is to allow of the roadway ripping being carried on simultaneously with the coal operation and it will be noticed that the ripping lip is shown between the gate belt conveyor and the coal face.

Small teams of men are generally employed in room-and-pillar systems and this has a three-fold advantage. A variety of work is done by each team during any shift and the monotony is greatly reduced; moreover, each man can, with comparative ease, be trained to undertake any job. In addition, the competitive team spirit enters into the picture with a definite advantage to all concerned. Furthermore, in this class of work, with a practically continuous cycle, it can be said that the work is never completed, and there is always something to occupy the men throughout the shift. This differs from the longwall system, where a complete cycle of operations is usually carried out once only in every 24 hours.

The great advantage of this particular method is that the cycle is so designed that coal is being filled continuously, except during such time as the face conveyor is being pulled forward (by the shortwall coal cutter) or when the second conveyor is being extended.

IMPORTANCE OF MAINTENANCE

In all these mechanised systems, maintenance is a matter for prime consideration. The trend in this country for many years now has been to design equipment which should have a very high standard of reliability

and which should be overhauled at the surface fitting shops where full facilities should be available. Many collieries have evolved a system of routine overhaul whereby both coal cutters and conveyors are brought out of the pit at specified time intervals for thorough inspection and overhaul. This system, where properly carried out, results in a high degree of reliability, and underground it is only necessary to organise daily attention to lubricating and routine checks at frequent periods of the electrical switchgear, etc. The accessibility of well designed machines is such that underground maintenance can be carried out with the minimum of difficulty by the maintenance staff.

It cannot be too highly stressed that the success of mechanisation as applied to our mines today is intimately associated with adequate and careful maintenance, both long-term and day-by-day.

(Illustrations referred to in this Paper appear on pages 249-255.)

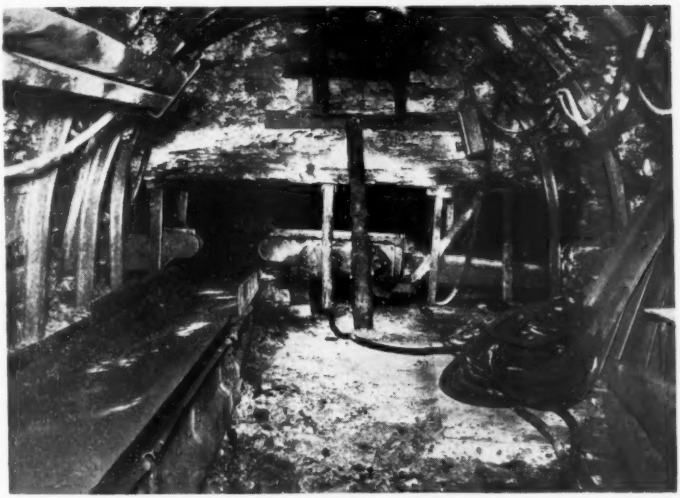


FIG. 1.

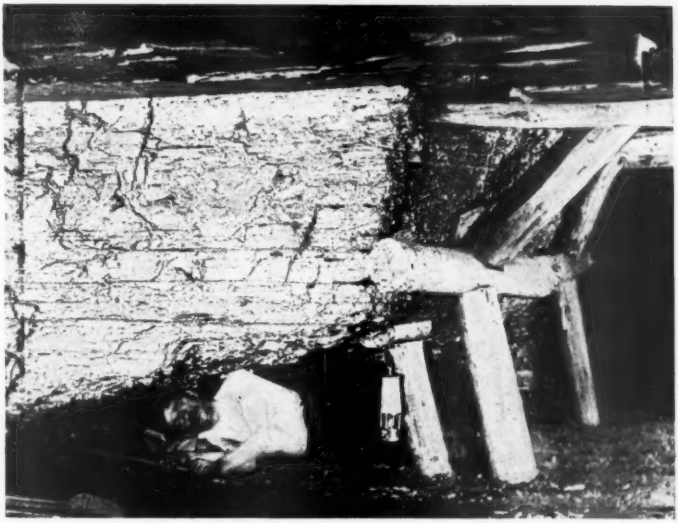


FIG. 2.

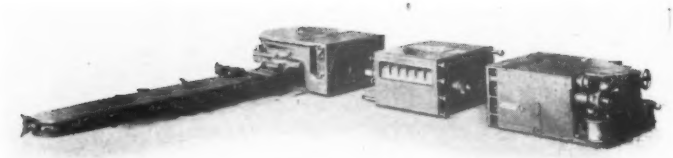


FIG. 3.

FIG. 4.

FIG. 5.

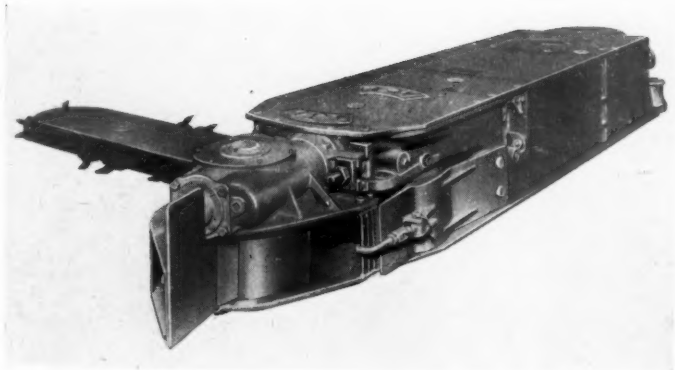


FIG. 6.

FIG. 7.

FIG. 8.

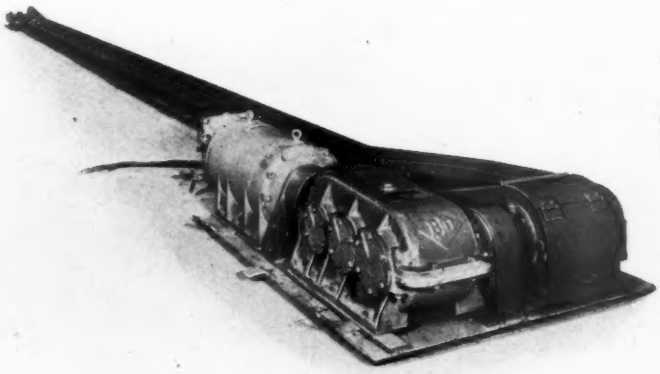


FIG. 9.

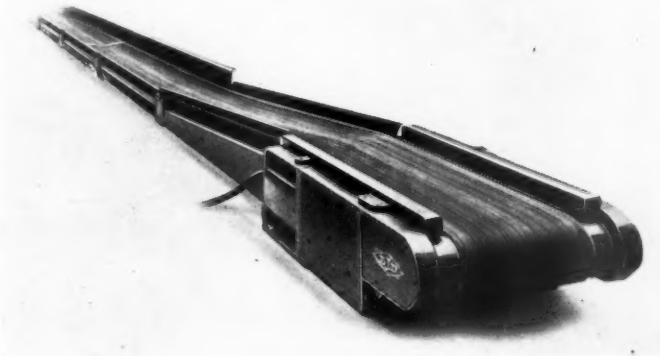


FIG. 10.

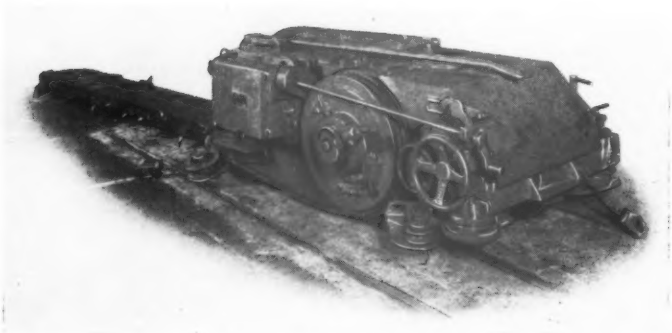
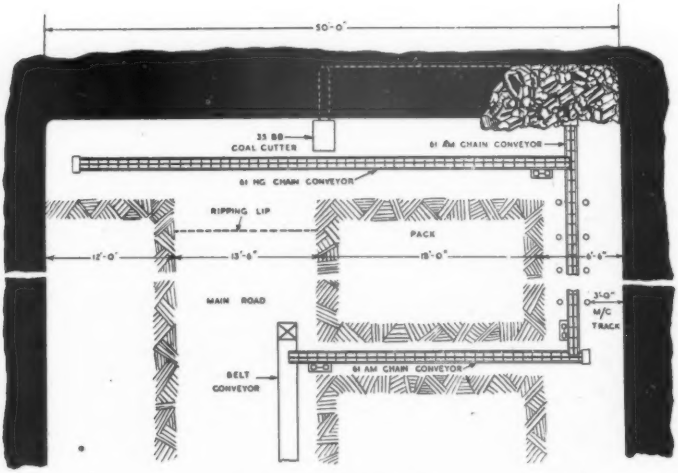


FIG. 11.



HEADING LAYOUT FOR
MAIN ROAD DEVELOPMENT

FIG. 12.

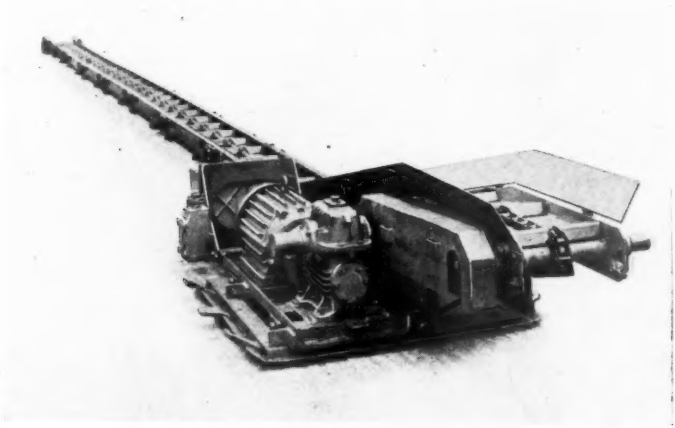


FIG. 13.

FIG. 14.

Notes

APPRENTICESHIP TRAINING

by B. P. COOPER, M.I.Mech.E.*

Presented to the Institution of Production Engineers, Leicester & District Section, November 14th, 1946; Nottingham Section, January 8th, 1947; South Wales and Monmouthshire Section, October 28th, 1947.

Apprenticeship training, like charity, begins at home. That is to say, that if children are not correctly influenced at home, they make very difficult material on which to work both at school and in after-life when called upon to take their place in industry.

It has been said that if a child's training up to seven years is correct, its future conduct will be along suitable lines. This may be an exaggerated estimate but it is worth some consideration. If an infant is given an expensive toy and some simple thing such as a tin or peg, it may prefer the commonplace thing to the expensive one. From the infant stage to early childhood it will enjoy simple working duties in preference to other forms of play if the work is presented in the form of a game. It is generally too late to break in a child to enjoy duty when it starts work, if, during its childhood, it has been encouraged to waste its time in uncontrolled play into which no sense of duty has entered. A dislike for any semblance of work and duty is inbred and a difficult problem child becomes a burden to school teacher, and to employer when school days have ended.

Contrary to impressions which are sometimes expressed, a study of the set-up of our educational system reveals that an appreciation of the need for craftsmen in industry is realised and is catered for. There may be cases where the particular Directors of Education and Schoolmasters do not interpret the plans in a way that we might think best, but it is believed that such cases are the exception rather than the rule.

A brief summary of our educational system as it affects training for later industrial employment is worth examination. The booklet published by the Ministry of Education entitled "The Nation's Schools," gives an outline of the Act of 1944, and this, plus the experience gained by personal contacts with some of the Leicester Education Committee's activities, is the basis of the following review.

* Chairman, Engineering Advisory Committee, Leicester College of Technology; Member of Engineering Advisory Committee, University College, Nottingham; Member of Juvenile Employment Committee, Leicester Education Authority.

The Nursery School provides for children aged 2 to 5. This phase of early education occurs only to a limited number of young children. Those who do attend at this early age learn to think, to talk, and to give and take.

The Infant School provides for children 5 to 8 years of age and is a very important part of the education system. At about 7 years the normal child ceases to be governed by infantile desires and looks to the future with some bewilderment and is at that time very susceptible to good or bad influence. By careful training the child becomes self-reliant, and it is suggested that this characteristic be developed to its fullest extent. Self-reliance and self-confidence are two of the main inherent qualities in making a good citizen and a good craftsman. Skill in reading, writing and handcrafts is developed during these years of school life.

The Junior School comes next in the normal education and caters for children of 8 to 11 or 12 years. Here the main objective should be to encourage pride in personal achievement and in particular to learn how to *do things well*.

After 11 or 12 years the child passes on to the Secondary School. Of Secondary Schools a revised set-up is made, there being three types of secondary education. That known as the Grammar School caters, in the main, for the professions, and has, as its objective the entrance examinations of Universities and some of the professions, but not that of the profession of Engineering.

The outlet to the industrial side of life is not likely to be augmented by the boys who attend these schools. There is, however, reason to hope that the extension of secondary education through the Secondary Technical School and the Senior or Modern School will have this effect. These schools will have their education related to future employment in constructive trades—engineering, building, etc. The Secondary Technical School must have our active support to cure the snobbish outlook of parents that education at such schools is inferior to that at Grammar Schools. No education should be narrowly vocational, and it is not the intention that such should be provided by the Secondary Technical School. It is stated in the booklet " The Nation's Schools " that the education given " will certainly enable them to embrace skilled employment with interest and competence."

So much for the outline of education leading to the point where a boy starts work.

HOME INFLUENCE

The other important factor in preparation for life's work is home influence, and here indeed is a difficult problem. The difficulties lie in the outlook, or lack of outlook, of the parent, falling under the following heads :—

(1) Those who consider that the employment of their children

should, immediately after they leave school, make the maximum contribution to the family exchequer.

(2) Those who want their boys to have a " white collar job " instead of entering a skilled manual trade.

(3) Those who remember the trade slump following upon the war of 1914-18 accompanied as it was by unemployment and relatively low wages in the engineering industry.

(4) Those who are indifferent and allow the youth to drift as he may in and out of any job irrespective of his future well-being.

It is felt that we engineers have an obligation to try to rectify some of these conditions, and it is to be regretted that the employers' organisation has not as yet given effect to suggestions made in various authoritative quarters. In this connection the Report of the Juvenile Employment Service, H.M. Stationery Office, price 1s., is worth reading. One or two quotations from this publication will serve to show the general tenor of the lines suggested.

Paragraph 73 : " Another most valuable service the expert from industry and commerce can give is to address *parents* and discuss with them the nature and opportunities of different careers."

Paragraph 96 : " It is clear that for some years to come there will be a shortage of juveniles and it is very desirable in the national interest that those industries of greatest importance to the nation should not go short."

Again, paragraph 98 : " Certain staple industries have of late years had difficulty in recruiting as many juveniles as they wanted. A responsibility lies on such industries to do all possible to make conditions as good as may be, having regard to the nature of the work, and to reduce the fear of insecurity by engagement on as long terms of tenure as possible. There appears to be an unwarranted prejudice against employment in some industries and we feel that this might be removed by judicious dissemination of accurate information. While it is the duty of Juvenile Employment Service to regard first the interest of boys and girls, we believe that it also has a duty to industry as a whole and that it should present to juveniles and *parents* the advantages as well as the disadvantages of unfashionable occupations, some of which no longer deserve to be discredited by shortcomings of the past."

The quotations from this Report have been given at length to show an example of the willingness of the education authorities to help.

AIDS TO RECRUITING BY EMPLOYERS

Other means which should be available are : a well-prepared film or films for the *whole* industry ; good literature ; an open day in the works for parents only of boys who are in their penultimate year at

school. The success of this last item would depend on the approach to and conduct of such a visit. If our works are not fit to be seen, then we don't deserve to obtain suitable recruits to apprenticeship.

As far back as March 1946 a committee was appointed by the Engineering & Allied Employers' Federation to examine the problem of recruitment of boys for engineering. This Committee consisted of eight men from the various districts in Great Britain who were briefed to prepare a common minimum Apprentice Training Scheme.

This scheme was to follow upon the memorandum No. 3 of the Central Juvenile Employment Executive, which in its turn followed upon the activities of the Minister of Labour, who in 1942 asked the representatives of the British Employers' Confederation and the Trades Union Congress to get together to consider the position of young persons in industry with particular reference to *training* before and during employment.

In 1945 these bodies had prepared a report entitled "Recruitment and Training of Juveniles for Industry." The main points were as follows :—

(1) The Ministry of Labour and National Service should encourage each main industry to set up, where a suitable organisation does not already exist—

(*a*) a National Joint Apprenticeship and Training Council or other appropriate machinery ; and

(*b*) special local Industrial Committees to work in co-operation with the Juvenile Employment Service.

(2) Each industry should be urged—

(*a*) to establish agreed standards of employment for its young workers ;

(*b*) to appoint qualified persons responsible for the recruiting, training and welfare of young workers, and, where appropriate, *apprentice supervisors*.

(3) Plans should be made for close collaboration between Education Authorities and organised industries.

The main objective of every good recruiting and training scheme should be to ensure that, having regard to their individual qualities, young entrants into industry are fitted in to the most suitable occupation and trained for those occupations. They should acquire adequate skill and adaptability as early as possible, opportunities for advancement for young workers of ability should be given, and last but not least, help should be given in the development of young workers into good citizens.

A scheme has been worked out, but at the moment it is not public, but it is hoped that in the near future this will be made available.

You will note the warning given above in the Report of the Juvenile Employment Service that there is and will continue to be a shortage of boys available to industry for some years. This will be increasingly the case, so that in the year 1955 only approximately half the present number of boys and girls under 18 years of age will be available for employment. This is due to (1) the impact of the decreased birth rate of past years, and (2) the raising of the school-leaving age. It does not take into account time lost to employment up to 18 years of age by attendance of one day per week at County Colleges, neither does it consider the loss due to military service after 18 years of age.

It has been felt a duty to call attention to the serious position before discussing the actual training of apprentices, for, unless we can recruit the right type of youth, we shall not require a training scheme.

We have allowed certain statements in regard to our industry to become established household quotations without proper challenge, and this must be broken down by dissemination of indisputable fact ; in particular, the phrase that the repetition work associated with engineering is " soul destroying." Exactly what may be defined as a destroyed soul is not clearly stated, but if it means that one whose soul is still intact is he who has to exert considerable mental and physical effort and, in addition, considerable time to accomplish a given task as opposed to one who by mechanical aids brought to his assistance can do his day's work with increasing freedom from worry and fatigue, then " destroyed souls " should be a very happy band. Is it, for example, to take extreme cases, more of a routine job to spend a working life in attaching nuts to the studs on motor car wheels than to count Treasury notes and coin behind a grille?

If the craftsman has a trained mind and ambition he will use the leisure accruing from the mechanical aids already afforded him to think out still more advanced mechanical aid, and if such thoughts are sound he will find those who are anxious to adapt his ideas to his own and the benefit of others. There is, however, a vast majority of people who do not wish to exercise the high degree of personal skill, effort, and worry of the old craftsman ; they work in order to live, and are glad that their calling is not difficult. There is yet another class of worker who has other laudable interests outside the means of livelihood, and who welcomes the advance of assisted production in order to have greater leisure for following reading, art, or maybe, gardening.

Let us praise the present advances made in giving leisure, and

encourage the boy entering our industry to appreciate the help given him, and point the way to his advancement and benefit in one or other of the lines just indicated.

Having dealt with some of the difficulties facing us in recruitment of suitable boys we will now consider some suggestions for training.

A SCHEME FOR TRAINING

It is recommended that in all large and medium sized firms it should be the duty of one individual acting under the direction of a committee to watch over the training provided.

It is necessary to determine in any large organisation the overall number of recruits required and in which departments they are needed.

Fig. 1 indicates one method by which this can be determined. It aims at showing at a glance how the income of youth should be regulated in relation to the likely retirement of older men at 65 years of age. It should be reviewed annually so that abnormal growth of business and other occurrences such as greater loss of personnel due to premature death or retirement may be catered for. On the incoming side you will note under "Apprentices" that 20 per cent. additional recruitment has been allowed for, to cater for normal loss of apprentices and adults, but an annual review is desirable to ensure that a drift does not occur. Moreover, the Departmental Analysis shown at the foot of Fig. 1 where the analysis of one department only is shown, pre-supposes that for certain departments special training is needed and an annual review assures that such preparation is not overlooked.

The preparation of the data for the chart is best obtained by one of the modern machine-operated punched card systems, but if this is impossible the hand-operated Paramount card system may be employed.

In a small works such information can very readily be dispensed with, provided a mental watch is kept on staffing problems.

To explain the details collected :—

The first line takes a review of 44 years ahead so that all adult employees between the ages of 21 and 65 may be included.

Line 2 gives these ages for the year before the one under review.

Lines 3 and 4 give the number of employees under each age group in the classifications " Skilled " and " Semi-skilled."

It will be noted that the employees who were 21 (viz. 60) would have been insufficient to replace the 30 plus 42 (i.e. 72) who were due to retire in the year 1945, on which the particular review was taken.

Under the heading "Apprentices" the age and number are given in lines five and six. The total number of 300 is given twice,

firstly under the years 1945 to 1949, and again under the years 1984 to 1989. This is done so that the number due to retire may be compared with the oncoming supply on the left hand, and also, on the right hand, the oncoming apprentices may be compared with the young adults—viz. it will be noted that in the year 1990 we will have 57 apprentices reaching 21 years of age to take the place of the 60 anticipated to be available at the year 1989, and so on.

We now examine the number required in relation to intake. We find by deduction made under the heading of " Needs " that we should take in 60 boys per annum to cater for anticipated loss by retirement. It will be noted that the total number of boys and apprentices between the ages of 15 and 21, i.e. six years, who should be in employment to cater for 60 per year, is 360, and since in the case of the illustration given only 300 are in employment, a larger intake is needed.

An example of a Departmental Analysis is given at the foot of the figure. This analysis is one of a Tool Drawing Office and is an example of good planning. It will be noted that the age distribution is very even, so that of the eighteen men engaged, there will only be one year in which more than one man will be due to retire at normal age.

The use of the departmental analysis is briefly described in general above, but this may be amplified, in particular as applied to preparation of apprentices for the Tool Drawing Office or similar production technical work. We have our attention drawn to the probability of four retirements up to and including 1949, thus giving time for special training of the candidates for this work. For example, if the workshop training of the apprentice has been exclusively in the Tool Room, he should serve a period in production departments to enable him to appreciate the use of jigs and fixtures in their intended work as opposed to the very limited test they might have in the Tool Room. Conversely, the apprentice who has elected to transfer in a few years time to the Tool Drawing Office, should be transferred to the Tool Room for a period of training, if his work up to that time has been exclusively in production departments.

A further use of the departmental analysis is that the Apprenticeship Supervisor will be able to direct the attention of apprentices to pending vacancies and discuss with them the lines on which their future choice of employment may be made. In addition to what may be done in adjusting workshop training, the apprentice who knows the future line of his employment can also adjust his technical education and reading to suit his future career.

It is very essential that any engineering firm which expects the

best of youths to become apprentices should have a clearly defined offer of training which will be of maximum benefit to both apprentice and employer.

It should be an obligation on the employer to teach the youth his craft, and not leave him to pick up in the works what he can from whom he can. Judging by the statements contained in the booklets on Apprenticeship which have been published by firms of repute in recent years, it would appear that this matter is receiving serious attention.

TRAINING SCHOOL

It is suggested that every large firm should have its Apprentice School where the elements of craft are taught, and that small firms should combine to provide the same facilities. Craft training as such is not the business of the Technical College, although some instruction may be given in the theoretical underlying principles as provided for jointly by the Ministry of Education and the Institutions of Mechanical and Production Engineers. For example, it is not the work of the College to teach a boy the correct use to which a range of files should be put or the correct approach of a hack saw blade or the pitch of its teeth to cut through angle iron or tubing.

CRAFT TRAINING LITERATURE

There is a very limited choice of literature on this subject. The best known of that available is that of the Ford Company of U.S.A., publishers McGraw-Hill Book Co., but the terms used in many cases are peculiar to American technological language, and the spelling is strictly American. The Ford Motor Company of England recognises these limitations and has edited the American edition for their use in the Apprentice School at Dagenham. The latter work is not published but it would be of great benefit if it could be. The author's Company has made its own revision of the American publication with the joint consent of the McGraw-Hill Co. and the Ford Motor Co. The preparation of the text and necessary blocks was a very big task for an individual company, but it is considered to have been worth while.

The set-up of each Apprentice School varies with the nature of the work carried out by the firm to which it is attached. For example, that of the Ford Company at Dagenham gives the full apprenticeship period to training in the school, and the graduates go out to Tool Room and other technical departments, but not, of course, to the manufacturing and assembly plants, where the training provided in the school is not required. The Rolls-Royce Company has its school in the Derby Technical College, and in return for accommodation provided by the College undertakes the

same training of apprentices to other local engineering firms. The Rolls-Royce Company, it is understood, provides the equipment, the tuition, and the examples and materials worked upon.

The writer's Company has its own way of dealing with the problem, and as this has proved satisfactory it may serve other similar engineering works and is therefore described in some detail.

Apprenticeship normally starts at the age of 16 years and is for a period of 5 years. There are two main grades of apprenticeship, the Craft and the Technical. In addition, facilities are offered to the youth who wishes to proceed to a University Course, to take a year's practical training prior to the degree course, and for vacation employment during his period at the University.

It is provided that the Craft Apprentice who has proved aptitude for technical work may transfer to the Student Class on obtaining his Ordinary National Certificate in Mechanical Engineering. The Student Apprentice is, save as just indicated, recruited from boys who have passed either the London Matriculation or Higher School Certificate examinations.

Both Craft and Student Apprentices pass through the Apprentice School. This phase of their training is divided into two sections in two separate departments. The first the school proper, and the second a special production department manned almost exclusively by youths and under the direction of a first-class craftsman who appreciates the difficulties of obtaining good work from youths of limited experience.

In the school proper the youth of 16 is trained from the craft sheets referred to above. This normally occupies some six weeks and at any one time the number of apprentices in attendance is limited to not more than ten, so that each youth can have considerable individual attention. On the conclusion of this course he will be in possession of a complete set of craft sheets covering some 30 subjects. The sheets, together with his notes, remain his property.

The method of training is to run through one subject per day in the form of a lecture followed by practical individual work on the subject taught. For example, if the subject taught is " Files and Filing " he will know which file to pick up to obtain a specified finish on a particular material. He will know why draw filing is employed, why files are single and double cut, and so on. If the subject be " Milling and Milling Cutters " he will similarly, following upon the verbal instruction, do practical work in the school. The school is provided with both blackboard and demonstration models for the lectures and with bench and various machine tools for the practical tests. The parts worked upon are parts from the Company's machines and are subject to the same inspection as parts coming from production departments.

If the boy graduates satisfactorily from this school he will pass on to the second stage where he will have a lengthy training on at least two of the major craft trades, i.e. on milling and grinding or any other combination of two or more. The Student Apprentice will, if he progresses well, have a rather broader training in the shops and will also have six months' experience in one of the drawing offices between the ages of 19 and 20½.

One of the objectives of this type of training is a curtailment of the time taken to make the youth really useful, at the same time stimulating his interest due to the fact that he receives a good general knowledge of most of the crafts employed in the works ; although ultimately he may only require to use one of them, say, turning, or milling, he nevertheless can appreciate some of the points to be observed in other of the crafts.

RECORDS OF PROGRESS

Figs. 2 and 3 show respectively the front and reverse side of the record of each apprentice from the time of signing of indentures to the completion of the five-year course. The front top portion of the card is straightforward, but some explanation is necessary in respect of the lower portion. Under the heading " Rating " a percentage figure is entered annually, which includes the average of four quarterly " Merit Ratings " taken by the Apprentice Supervisor in collaboration with the head of the department in which the apprentice is employed, and deals exclusively with his shop work. Under the heading " Bonus " the terms Shop and Class are bracketed, and relate to money payments which take account of workshop and Technical College progress. The award is graded in relation to age as follows :—

For each month of satisfactory progress in both categories the bonus for age is—

16	17	18	19	20 years
6s.	7s.	8s.	9s.	10s.

The cash must be converted into an award in kind—books, tools or instruments. No award is given to the youth who does not attend Technical classes. The asterisk denotes that the rating is a combined one, as made clear on the reverse side of the card.

" Potential field of activity " is used at the time when an apprentice is at the end, or nearly so, of his indentures. At this time the young man is interviewed and it is ascertained wherein lies his preference for a particular class of work, and as far as is possible his wishes as to his future employment are met. At the same time he is informed of the most suitable employment for his ability as seen by the Company. A further point of interest is that the grade of

apprenticeship in the top right-hand corner has been changed from " C " (meaning craft) to " T " (technical). The reason for this is explained in Fig. 4.

Fig. 3, which is the reverse side of the card, shows that after attending evening classes for three years, the boy has passed his Ordinary National Certificate in Mechanical Engineering, and has been transferred from the Craft to the Technical grade and is thereafter entitled to attend the Technical College for one-third of his working time, with payment at day-work rate of pay. This will allow the youth to proceed to his Higher National Course in Mechanical or Production Engineering, as advised by the Apprentice Supervisor—generally in the case of this Company to the former, because its greatest need is for men with a sound knowledge of the dynamics of machines and mechanisms.

The rating entered on the front of the card (Fig. 2) is the sum of the four figures 13, 15, 14, 18, i.e. 60 on the reverse side (Fig. 3) and is arrived at by consideration of both workshop and technical progress. Other entries are self-explanatory.

MERIT RATING

Fig. 4 shows the headings under which the apprentice is rated quarterly. Prior to the introduction of this method, a return was made by the foreman of the department in which the apprentice was working under the very non-committal terms of " Fair," " Good," " Very Good," etc. To interpret these terms as between one foreman and another it was necessary to merit rate the foreman and multiply his assessment by some factor either greater or less than unity.

The terms of review are shown to be very searching, and since the Apprentice Supervisor enters the figures after consultation with the foreman, a better common relation between one youth and another is recorded, and an opportunity afforded the Supervisor of pointing out to the youth any weak features. It will be noted that the total possible number of marks is 100 and that considerable importance is attached to executive ability and initiative, i.e. 25 marks.

An explanation is necessary of the sixth item " Compensation." If, for example, the past record of a youth is good, and in the quarter under review he has, say, a boil on his neck, it is likely that his work has suffered and a plus compensation might be given. If, on the other hand, his timekeeping and behaviour has been such that the deduction of the full 15 marks under item one seems insufficient, a minus figure might be entered under the Compensation heading. The introduction of this scheme has been of great benefit.

The activities of apprenticeship training are watched over by a committee representative of various sections of the Company's activities, presided over by the Works Director.

Each youth is photographed on the conclusion of his indentures, so that, in addition to a name and a record, an aid to memory of the type of youth is available. Thus, if a vacancy occurs above the level of a craftsman, the records of a likely candidate can be augmented by the photograph, giving an idea of his character and general appearance.

AWARDS Prizes in kind are given for successes in technical education—

Ordinary Certificate in Mechanical Engineering	£3 3 0
Higher Certificate in Mechanical Engineering	£10 10 0
Inter B.Sc.	£10 10 0
Final B.Sc.	£25 0 0
Whitworth Scholarship (Special Help)	—

The Company's apprentices have, within recent years, won two Whitworth Scholarships, and during the first two years of the award of the Hele-Shaw Medal by the Institution of Mechanical Engineers, the honour came to youths trained in these works and at the Leicester College of Technology.

THE FUTURE OF APPRENTICESHIP As indicated earlier, we, as engineers, are faced with a serious shortage of juvenile labour, particularly in cities where employment is diverse and many other trades offer higher starting wages than those at present operating in engineering. Certain of these offers should be ruled out by legislation and others are limited to the number of youths available. In the former class come the page-boy and the van-boy, and in the latter the garage-boy, and other trades where the youth will reach a dead end. It is realised that such action is drastic, but the reply may well be that it is a greater offence to tempt a boy into a blind alley job than to employ him more than the statutory 44 hours per week now ruling in factories.

No industry should recruit a greater number of boys than is necessary to make good losses of adult male workers, unless it is anticipated that by the time these recruits reach manhood, the growth of that industry will provide adult employment for that greater number. The chart shown in Fig. 1 serves the dual purpose of assuring that recruitment is sufficient and not too great.

In our industry we must see that we make the best use of the boys available.

A boy should not run errands for longer than is necessary to learn the geography of the works. Training should be intensified on the lines indicated above, and, in the case of small works, joint action should be taken in sharing a training school. The boy's interest should be stimulated by his rapid acquirement of skill,

and he should be encouraged to regard work as an art, rather than merely a means of preventing starvation, and acquiring funds to enable him to have fun.

The material we have to teach is not, perhaps, the best, but it is hoped that the raising of the school leaving age and the compulsory daytime attendance at County Colleges provided for in the Education Act of 1944 will, in spite of consequent loss in numbers, produce a better type.

It must be borne in mind that in the future we shall have to compete on the one hand with the low wages and intensive application of the German worker, and on the other with the high wages and very efficient output of the Americans. The Germans give an intensive and relatively short apprenticeship training, and the Americans do not stint their youth in the matter of education.

If we are proud of our calling and ensure that our youths receive the best possible training, then the engineering industry is assured of becoming what it deserves to be—the mainstay of the country's healthy industrial activity.

(Illustrations referred to in this Paper appear on pages 271-274.)

LABOUR CENSUS—NOV. 1944

AGE DISTRIBUTION—ADULTS—TOTAL 2200

YEAR OF RETIREMENT.	1945	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
AGE 1944	65	65	64	63	62	61	60	59	58	57	56	55
SKILLED NUMBER	30	42	40	40	41	43	29	28	36	48	50	51
SEMI SKILLED NUMBER	0	0	0	0	0	0	2	4	1	5	6	3

AGES 54-35 OMITTED HERE, BUT INCLUDED ON ORIGINAL.

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	34	33	32	31	30	29	28	27	26	25	24	23	22	21
POTENTIAL EX:														
	30	31	36	46	45	47	40	29	20	70	30	36	40	60
	7	7	5	5	6	9	5	8	7	12	8	7	6	12

APPRENTICES

AGE	20	19	18	17	16	15
NUMBER	57	61	63	49	30	40

TOTAL APPRENTICES & BOYS 15 YEARS 300 ⊕

AGE	15	16	17	18	19	20
NUMBER	40	30	49	63	61	57

NEEDS	TOTAL EMPLOYEES IN WORKS 2500	PRESENT POSITION OF INTAKE
65-21 = 44 YEARS		
2200 ADULTS ÷ 44 YEARS		
= 50 PER ANNUM	2200 + 300 = 2500	360-300 APPS + BOYS
+20% FOR LOSSES = 60 PER ANNUM		
6 YEARS (15-21) × 60 = 360		60 SHORT ⊕

DEPARTMENTAL ANALYSIS

YEAR OF RETIREMENT.	1945		1947	1948	1949	1954		1962	1963	1964	1968	1970	1971	1972	1980	1982	1983	1986	1987
AGE	66		63	62	61	56		48	47	46	42	40	39	38	30	28	27	24	23
NUMBER	1		1	1	1	1		1	1	1	1	1	2	1	1	1	1	1	1
			*																

*NOTE! HAVE WE 4 SUITABLY TRAINED APPRENTICES TO JOIN THIS STAFF?

Fig. 1

APPRENTICE RECORD CARD

NAME WILSON, John APPR. C T

ADDRESS —

DATE OF BIRTH 19.1.1924 INTRODUCED BY Father (William Henry)

SCHOOL Junior Tech. FORM EXAMINATIONS Sch. Cert.

COMMENCED WORK 20-4-1939 INDENTURED 19.7.1940

GENERAL

Well built boy - good type

Psych. Test $\frac{385}{400}$

POTENTIAL FIELD OF ACTIVITY

(e.g Designer etc - filled in at conclusion of apprenticeship)

* Rating	Year	BONUS				£	s.	d.
60	1941	Shop 100%	3	12	-	3	19	6
		Class						
		Fee 100%		7	6			
65	1942	Shop 100%	4	4	-	4	14	6
		Class						
		Fee 100%		10	6			
65	1943	Shop 100%	4	16	-	5	9	-
		Class						
		Fee 100%		13	-			
70	1944	Shop 100%	5	8	-	6	3	6
		Class						
		Fee 100%		15	6			
		Shop						
		Class						
		Fee						
		Shop						
		Class						
		Fee						

MS 61 The British United Shoe Machinery Co. Ltd.

FIG. 2.
272

APPRENTICESHIP TRAINING

		JULY—SEPT	OCT.—DEC.	JAN.—MAR.	APR.—JUNE
1941	Dept. Craft	TURNING	-	-	-
	Merit Rating	65 * 13	67 * 15	66 * 14	75 * 18
	Evening Classes	TECH. COLL. S1 - att. 85%		Report - Good.	
	Day Classes				
1942	Dept. Craft	TURNING	-	GRINDING	-
	Merit Rating	75 * 18	70 * 18	70 * 14	72 * 15
	Evening Classes	TECH. COLL. S2 - att. 82%		Report - Good.	
	Day Classes				
1943	Dept. Craft	MILLING	-	-	-
	Merit Rating	72 * 15	75 * 15	77 * 17	80 * 18
	Evening Classes	TECH. COLL. S3 - att. 85%		Report - V. Good	
	Day Classes	Obtained ORDINARY NATIONAL CERT.			
1944	Dept. Craft	MILLING	-	DRAWING OFFICE.	-
	Merit Rating	77 * 17	77 * 18	80 * 17	81 * 18
	Evening Classes				
	Day Classes	TECH. COLL. YR 1 HIGHER NATIONAL COURSE			
	Dept. Craft				
	Merit Rating	*	*	*	*
	Evening Classes				
	Day Classes				
	Dept. Craft				
	Merit Rating	*	*	*	*
	Evening Classes				
	Day Classes				

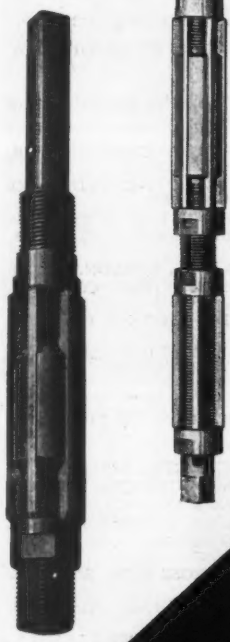
FIG. 3.

APPRENTICE MERIT RATING.	VALUE
1. TIMEKEEPING, HEALTH AND BEHAVIOUR	15
2. ENERGY AND INDUSTRY	20
(a) INTEREST IN WORK	
(b) SPEED OF WORK	
3. RELIABILITY	20
(a) ABSENCE OF SCRAP	
(b) CLEAN AND NEAT IN METHOD	
(c) CO-OPERATION	
4. RECEPTIVENESS AND SKILL	20
(a) ABILITY TO LEARN QUICKLY	
(b) LITTLE INSTRUCTION NEEDED	
5. EXECUTIVE ABILITY AND INITIATIVE	25
(a) ABILITY TO MAKE USEFUL SUGGESTIONS	
(b) KEENNESS TO ACQUIRE NEW KNOWLEDGE	
(c) ABILITY FOR LUCID EXPLANATION	
6. COMPENSATION	
TO BE APPLIED AT THE DISCRETION OF THE APPRENTICE SUPERVISOR	

FIG. 4.

Notes

EXPANDING REAMERS



EXPANDING HAND REAMERS
T & J Expanding Hand Reamers with blades of High Speed Steel are offered in a wide range of sizes from ¼" to 2¾" as standard ranges. They are available with four, five or six blades according to size and pattern. Made of first class British materials in a factory planned specially for the production of Engineers' Small Tools, they provide a comprehensive range equal to the most exacting demands of the discerning user Individual reamers are packed attractively in cardboard boxes and complete sets in wooden cases are available for workshop or garage use.

EXPANDING PILOT REAMERS
The T & J Expanding Pilot Reamer is designed specially for use on Stub Axle and Piston bushes but lends itself readily to line reaming of any sort within the capacity of the range. An independent expanding front pilot is integral with the cutting blades, giving positive setting and ensuring correct alignment. The blades throughout are of High Speed Steel.

LEA-TAYLOR MULTI TOOL HOLDER
The Lea-Taylor Multi Tool Holder is a patented device incorporating a spring-loaded box-form holder in which, by the use of suitably shaped shims, various sizes of tool bits can be used. This makes unnecessary the use of a holder for each size of tool bit and the positive action of the holder is a considerable factor in the saving of High Speed Steel. This holder is available in a range of five boxed sets, each complete with a range of tool bits.

made by TAYLOR & JONES, LTD., Honley, Nr. Huddersfield

— and sold by all Good Tool Merchants

Horses de combat

All over the country—said a leading diagnostician—eager workers are falling at their benches in a state of cocoa . . . pardon—coma. Such collapses occur after prolonged spells of repetitive, monotonous, although not necessarily arduous work. The Victim is usually well nourished (in the Works Canteen) and there is little indication that the exertions of the 5-day week are too much for him. What then, is the explanation? I direct your attention to the archaic implement clutched in the patient's hand. FRUSTRATION, gentlemen (cried the digno—the diagono, the dingo—the whoosit)—MANIPULATIVE FRUSTRATION* (he boomed) has brought on an acute fit of nervous debility. The remedy for such complaints is simple—

STAND C.415 B.I.F. BIRMINGHAM

call up the LITTLE horses

*MANIPULATIVE FRUSTRATION is a new industrial disease thought up by our advertising chaps. The cure is to use power driven tools in place of hand-tools. But the tools *must* be powered by Desoutter's Little Horses or what's the point of our advertising.

DESOUTTER

Specialists in Lightweight Pneumatic and Electric Portable Tools.

DESOUTTER BROS. LTD., THE HYDE, HENDON, LONDON, N.W.9. PHONE: COLINDALE 6346-7-8-9.

C.R.C. 185

Bearing Cup's proud boast

Above is a portrait of a Cycle Bottom-bracket Bearing Cup, with its diploma tied round its neck. Cut from Mills Ledloy steel, it boasts a production increase of 26% over its rival, cut from ordinary steel under parallel conditions. Twenty-six per cent. . . . that's a lot . . . but the Mills Ledloy case-books record other examples where the gain is even more dramatic, sometimes as much as a hundred per cent. And, in every case, Mills Ledloy steel is far kinder to machine tools than other steels are.

MILLS LEDLOY

EXORS OF JAMES MILLS LTD.

BREDBURY STEEL WORKS.

WOODLEY. Nr. STOCKPORT

LEDLOY is the name given to steels into which a small percentage of lead has been introduced by a special process. All steels (carbon and alloy) can be so treated during their manufacture.

STOCKHOLDING AGENTS:

LONDON
Brown Brothers Ltd.
Buck & Hickman Ltd.
Farmer, Stedall & Co.
Mosers Ltd.
W. & C. Tipple Ltd.

MANCHESTER
Alfred Simpson Ltd.

BELFAST
Kennedy & Morrison Ltd.

BIRMINGHAM
Chas. Wade & Co. Ltd.

BRISTOL
Godwin, Warren & Co. Ltd.

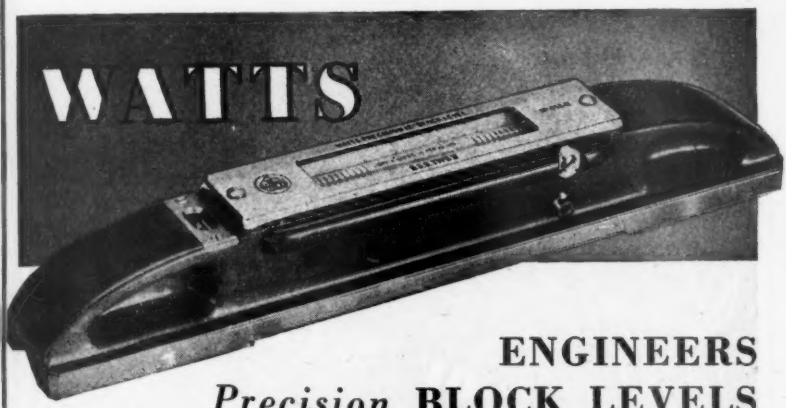
NORTHAMPTON
A. H. Allen & Co. Ltd.

GLASGOW
John & Chas. Murray

KEIGHLEY
John W. Laycock Ltd.

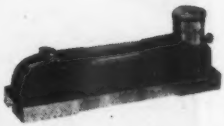
NEWCASTLE-ON-TYNE
Guest, Keen & Nettlefolds L.d.

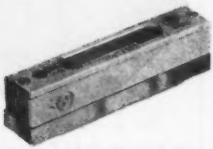
NOTTINGHAM
Associated Engineering & Electrical Supplies Co. Ltd.



ENGINEERS
Precision BLOCK LEVELS

Watts' Precision Block Levels are highly developed instruments of advanced design ensuring a fine adjustment of the bubble in relation to the base, together with maximum rigidity and stability in the metal frame. These Block Levels are indispensable equipment in workshops and inspection rooms, providing the engineer with the means for speedy levelling in assembly, testing and installing of machine tools and inspection of machined surfaces for flatness, alignment, parallelism, etc.





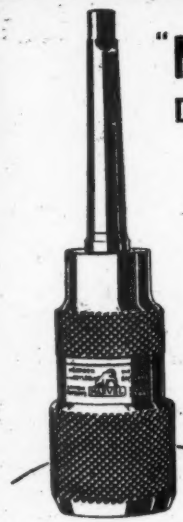
Above is illustrated the 12" Standard Precision Block Level and on the right, the 8" Square, the 8" Adjustable and the Angle Gauge Precision Block Levels. Write for details of full range — List JIPE/13.

E. R. WATTS & SON, LIMITED *Scientific Instrument Makers*
CAMBERWELL · · LONDON · · S.E.5

INDEX TO ADVERTISEMENTS

Page
—
xii
x
—
—
xxii
xl
—
xlvii
—
lv
—
xi
xli
iv
xlix
—
xviii
xiii
lvii
lviii
lv
xxi
lvii
—
lviii
xxiii
vi
—
xlvii
xvi
xlv
xiii
xxii
xii
iii
Cover
xi
xxxi
v
xviii
lvi
xi
xxxii
xvii

CHUCKS FOR MODERN HIGH SPEED DRILLING PRODUCTION



THE "MARVEL" KEYLESS & THE "ARCHER" KEYLESS DRILL CHUCKS

are designed and constructed to stand up to modern drilling practice. The external design is robust and serves as an efficient casing to protect the internal mechanism. The jaws are protected from damage by the specially hardened boss or cap. The demand for this perfect chuck increases every year, evidence that the leading engineers appreciate its worth.

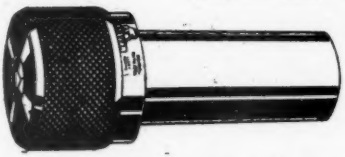
FIVE SIZES FROM $\frac{1}{16}$in. TO $\frac{3}{4}$in.

ASK FOR OUR CHUCK CATALOGUE 5G

The "ARCHER" KEYLESS DRILL CHUCK

is a correctly designed small size chuck working on the same principle as the "Marvel" which ensures reliable grip and ease of release. It has permanent concentricity and perfect balance for high speed drilling.

TWO SIZES: 0-$\frac{1}{4}$ in., 0-$\frac{3}{8}$ in.



TURRET STYLE *"Marvel"*

Shanks made solid from body giving short overhang for rigidity and alignment.

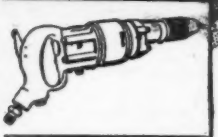
Tools quickly changed by hand without disturbing chuck setting.

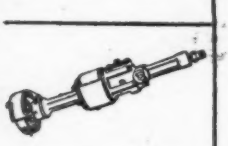
Made in all capacities and various shank diameters.

FRANK GUYLEE & SON Ltd.

'ARCHER' TOOL WORKS, MILLHOUSES · SHEFFIELD 8

MORE POWER TO YOUR ELBOW!





Holman Pneumatic Tools become more and more indispensable to locomotive, coach and wagon shops equipment. They replace much arduous handwork and speed up many preparatory operations.

Rotodrills are light in weight, simple in construction and free of vibration. If stalled, a drill will restart immediately the feed is released. The range includes Screw Feed Type, Close Quarter, Wood Borers and General Purpose Drills.

Chipping Hammers. These are tools that all operators like to use and the full range enables the right tool to be used for the right job.

Grinding & Fettling Tools. The Rotogrind series give a choice of tools with a wide variety of application. 0/1 is the high speed job. Its weight is 4 lbs. all on and it will rev. up to 16,000 r.p.m. Its light weight makes it a first-class tool for such delicate jobs as die dressing and its power and speed make it suitable for much general purpose work. Sizes 2 and 4 will take any grinding or fettling work that come their way, their power/weight ratio is very high and they are the ideal tools to carry fast cutting wheels. No. 5 is the Surface Type grinder and fettler, ideal for fettling large castings, and smoothing off welds.

Holman

PNEUMATIC LOCO & WAGON SHOP TOOLS

The first name for lasting service

HOLMAN BROS LTD · CAMBORNE · ENGLAND

R.P.15.

All communications regarding advertisements should be addressed to the Advertising Managers, T. G. Scott & Son, Ltd., Talbot House, 9, Arundel Street, London, W.C.2. Phone: Temple Bar 1942.
Printed by Maxwell, Love & Co. Ltd., 10-15, Bradley's Buildings, White Lion Street, London, N.1.

V!

able to
e much
ations.
free of
feed is
Quarter,

e to use
ght job.
give a
he high
16,000
delicate
able for
rinding
ratio is
wheels.
fettling

OLS

AND
new

agers,
1942.
N.J.